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LOWER MISSISSIPPI REGION COMPREHENSIVE STUDY. APPENDIX R. POWER--ETC(U)
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Lower Mississippi Region

Comprehensive Study

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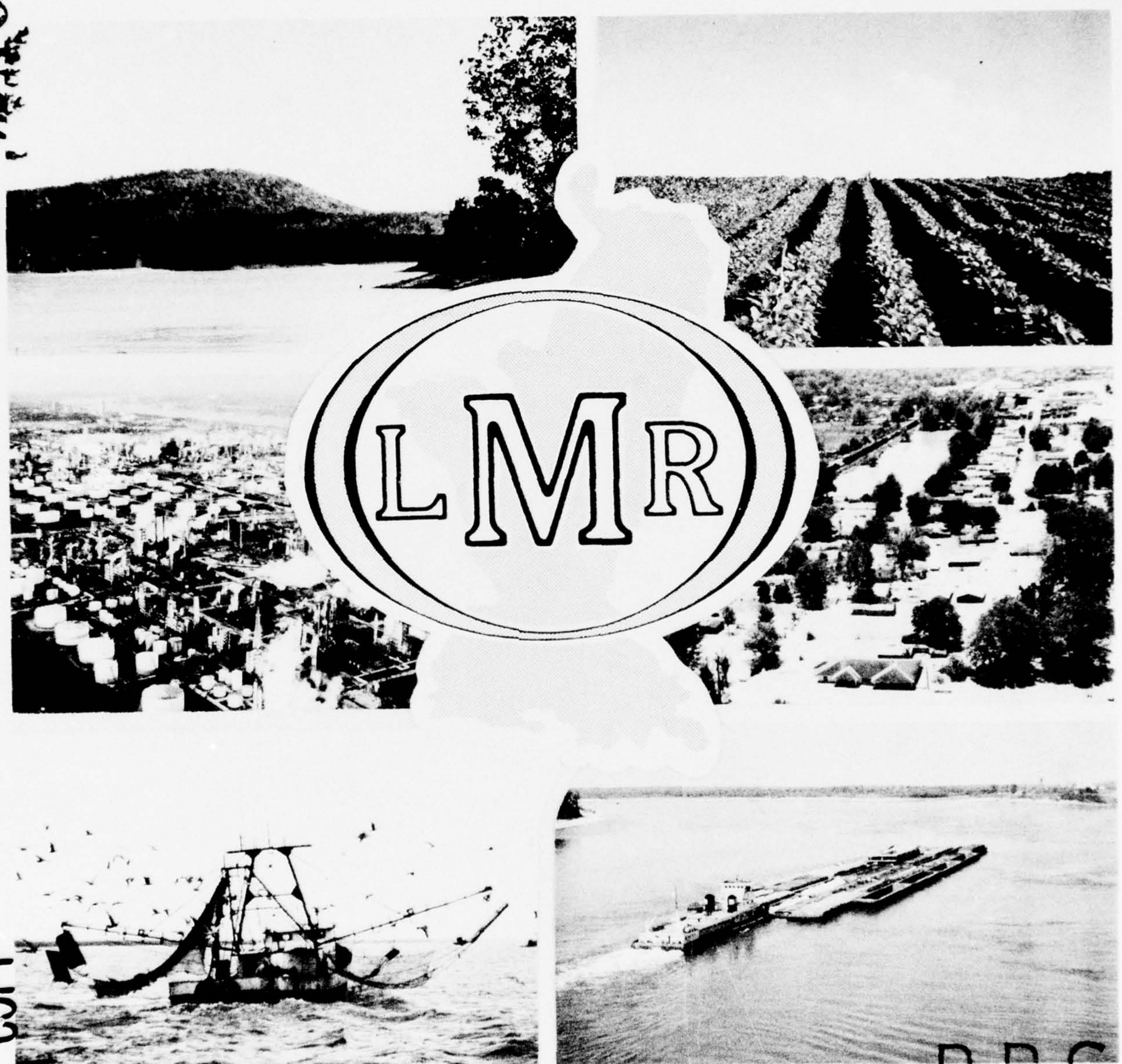

Appendix R

Power

1974

This appendix is one of a series of 22 documents comprising the complete Lower Mississippi Region Comprehensive Study. A list of the documents is shown below.

Main Report

Appendixes

Appendix	Description	Appendix	Description
A	History of Study	K	M and I Water Supply
B	Economics	L	Water Quality and Pollution
C	Regional Climatology Hydrology & Geology	M	Health Aspects
D	Inventory of Facilities	N	Recreation
E	Flood Problems	O	Coastal and Estuarine Resources
F	Land Resources	P	Archeological and Historical Resources
G	Related Mineral Resources	Q	Fish and Wildlife
H	Irrigation	R	Power
I	Agricultural Land Drainage	S	Sediment and Erosion
J	Navigation	T	Plan Formulation
		U	The Environment

POWER

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LOWER MISSISSIPPI REGION COMPREHENSIVE STUDY.

Appendix R.
Power.

PREPARED UNDER THE SUPERVISION OF
THE LOWER MISSISSIPPI REGION COMPREHENSIVE STUDY
COORDINATING COMMITTEE

This report was prepared at field level by the Lower Mississippi Region Comprehensive Study Coordinating Committee and is subject to review by interested Federal agencies at the departmental level, by Governors of the affected States, and by the Water Resources Council prior to its transmittal to the President of the United States for his review and ultimate transmittal to the Congress for its consideration.

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PHOTOGRAPHS

The photographs included in this appendix were furnished by:

I N T R O D U C T I O N

SCOPE

In order to expedite and give meaning to its studies of the power industry the Federal Power Commission, some years ago, divided the country into power supply areas (PSA's). The boundaries of power supply areas are set according to the service areas of major electric utilities, groups of utilities, and operating power pools. The data for each power supply area, however, represents full coverage of all utilities in the area, large and small, regardless of ownership except that industry-owned generation is not included in this report unless specifically noted. The growth of interconnections, the expanded use of extra high voltage (EHV) transmission, and the increasing size of generating units have made additional coordination among individual systems on an area basis essential in insuring the reliability of electric bulk power supply and for sharing in the advantages resulting from coordinated planning of joint power supply.

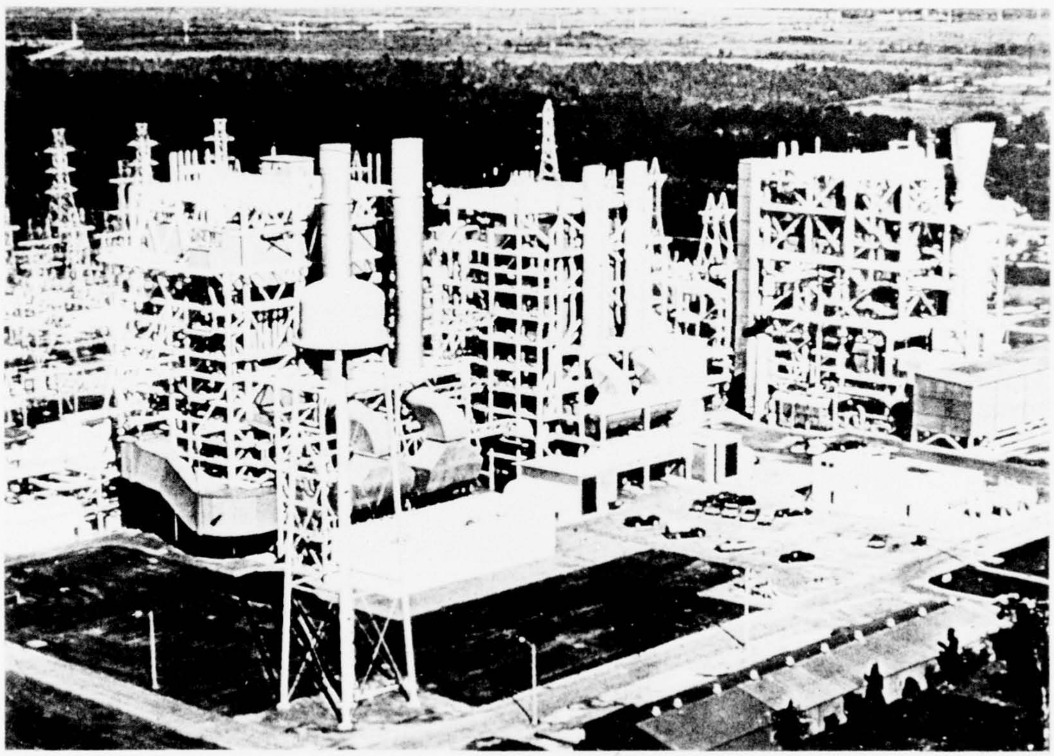
The study of electric energy generation and distribution for this report has been related primarily to PSA's 25, 29, 33, 34, and 35 which essentially represent the area served by systems of the Southwest Power Pool, a regional reliability and coordinating organization, and encompassing the principal market area for hydroelectric power generated in the Lower Mississippi Region. This market area includes the States of Arkansas and Louisiana and portions of Kansas, Mississippi, Missouri, Oklahoma, and Texas but excludes portions of Illinois, Kentucky, and Tennessee which are within the Lower Mississippi Region. Federal power in the Lower Mississippi Region is marketed by the Southwestern Power Administration except that hydroelectric power developed in these latter areas would be marketed by the Southeastern Power Administration. The major portion of the Lower Mississippi Region lies in PSA 25 which is served to a major extent by Middle South Utilities and associated systems. The basin also includes part of PSA 35 in which Gulf States Utilities Company is the principal electric utility. Of the twenty-eight members of the Southwest Power Pool, nine, including Middle South Utilities, operate extensively in the Lower Mississippi Region.

An analysis of power requirements was made with base power loads and resources being those for the year 1970. Detailed projections are available only to the year 1990 which provides for extraction of data by PSA's for the projection year 1990. The only electric power data presented herein for the years 2000 and 2020 have been "trended" in terms of the entire power market area.

Projections are based on population growth consistent with the national income program except for the Lower Mississippi Region's Water Resource Planning Areas (WRPA's) for which needs have been derived for both the national income program and the regional development program

OBJECTIVES

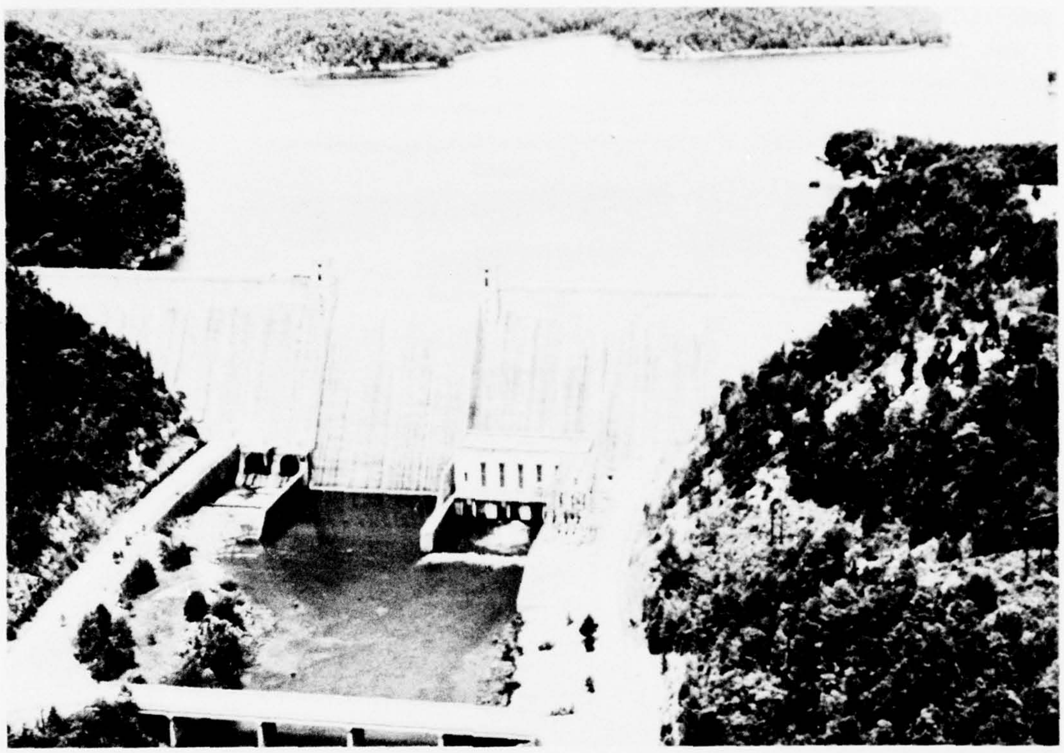
The objectives of this appendix are (1) to place the electric power industry in the Lower Mississippi Region in the proper perspective when viewed in the matrix of environmental and economic values, (2) to quantify the magnitude of electric power needs consistent with the study's economic parameters, (3) to assess water and related land resource capability to meet these needs, and (4) to provide the base from which a flexible plan, easily modified as future values and preferences change, can be formulated.



Louisiana Power & Light Company's 1,250.8-MW Little Gypsy Plant is in PSA 25 and is on the Mississippi River.

RELATION TO OTHER APPENDIXES

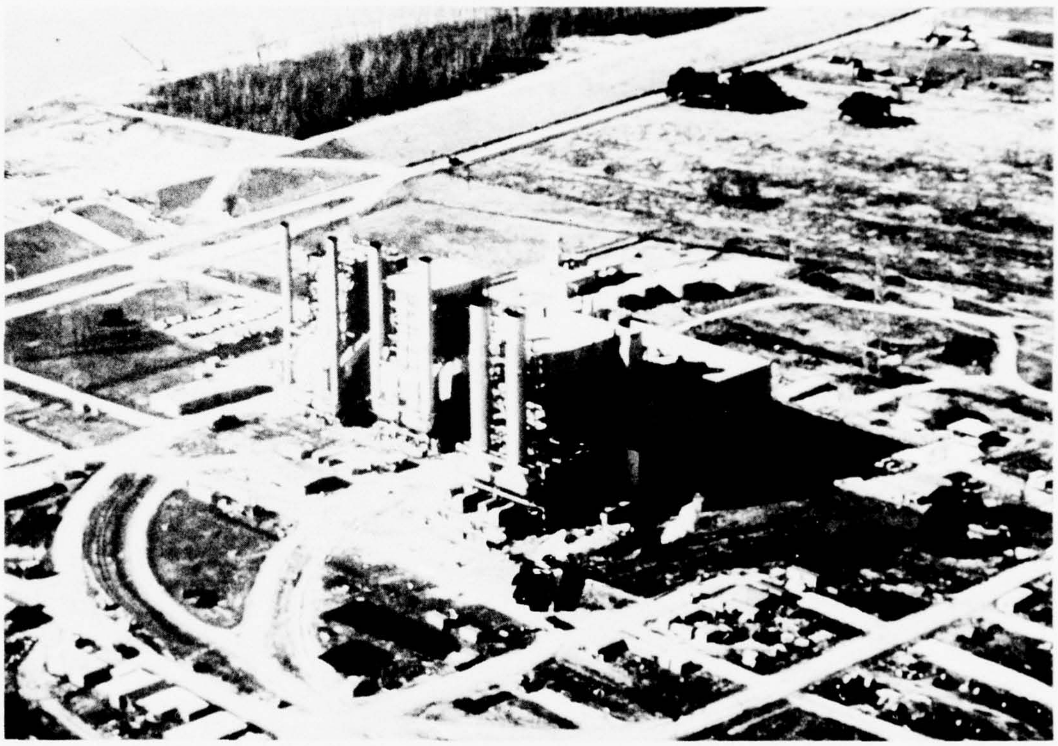
In this comprehensive basin study the various appendixes are related through the use of common population projections which make the various study elements interdependent on each other. Data developed herein on water requirements for hydroelectric and thermal-electric generating plants are reflected in other appendixes. Compatibility has been attained through review and conference.



The U. S. Corps of Engineers 25.5-MW Narrows Project on the Little Missouri River. Initial phase was completed in 1950. Third generating unit added in 1969.

PREPARATION AND COORDINATION OF APPENDIX

The Fort Worth regional office staff of the Federal Power Commission supplied the inventory of power resources and needs, including cooling water requirements for steam-electric generation, and assembled the appendix into its final form. The Southwestern Power Administration supplied resources and needs data which is a part of the whole but, relates specifically to preference power customers. The Vicksburg District of the Corps of Engineers screened potential hydroelectric projects within the Lower Mississippi Region for plan formulation consideration. Some of the data used in this appendix was extracted from reports which have been previously compiled, or are in some stage of preparation. The appendix was coordinated within the Power Subcommittee and the Plan Formulation Committee prior to review by the Coordinating Committee and the other subcommittees.



Gulf States Utilities 994.4-MW Willow Glen steam-electric generating plant located on the Mississippi River.

MARKETING TO SOUTHWEST POWER POOL AREA SYSTEMS

MARKETING TO SOUTHWEST POWER POOL AREA SYSTEMS

DESCRIPTION OF POWER MARKET AREA

General Description

Each electric utility system has the responsibility to (a) provide enough power and energy to supply its customers' requirements, and (b) to provide transmission facilities adequate to furnish the electrical requirements of its customers at system load centers. While each system holds itself ready, able, and willing to provide such service it has been found that due to the magnitude of present day electric loads and the problems pertinent to system expansion, individual systems can usually discharge their basic power supply responsibilities and increase the reliability of bulk electric power supply more efficiently through participation in coordinated planning. The selection of PSA's 25, 29, 33, 34, and 35 as the power market area, see figure 1, covers the service area of the Southwest Power Pool which is a coordinating and reliability group and not an operating pool. Nine of the eleven major power marketing systems in the Lower Mississippi Region are members of the pool. The Tennessee Valley Authority (TVA) and the Memphis municipal system are other major electric power suppliers in the Lower Mississippi Region. TVA has contracts, through Mississippi Power and Light Company, for exchange of seasonal diversity electric capacity with members of the Southwest Power Pool. The systems within the pool, through varying degrees of coordinated operations, share reserves, provide mutual assistance in emergencies, stagger construction of new generating capacity, participate jointly in the financing and construction of large sized units, construct long EHV transmission facilities, jointly arrange seasonal diversity interchanges, make maximum use of peaking hydroelectric capacity, and improve service reliability. Data presented herein for each power supply area represents full coverage of all utilities in the area, large and small, regardless of ownership, with occasional adjustments of data required for utilities which overlap power supply area boundaries. Load forecasts include loads in the area whether met by system generation in the area or by imports from outside the area.

**LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY**

**MARKET AREA FOR ELECTRIC POWER
FOR
LOWER MISSISSIPPI REGION**

FIGURE 1

Population

Estimates of population in the Lower Mississippi Region are presented in Appendix B, Economics. The population of the power market area, as estimated from 1970 census data, is as follows:

Table 1 - Population in Power Market Area - 1970
(Thousands of Persons)

Power Supply Area	Farm	Non-Farm	Total
25	455	4,331	4,786
29	202	923	1,125
33	347	3,264	3,611
34	465	2,536	3,001
35	148	1,961	2,109
Total	1,617	13,015	14,632

Population estimates prepared from Bureau of Census data were adapted to power supply areas and used extensively in the development of the load forecasts presented in this report.

Concentrations of population and industrial loads tend to centralize electric loads in certain areas. Locations of load centers are necessarily generalized and include loads of the surrounding area. Major load centers in the Lower Mississippi Region and their peak loads including reserve requirements for 1970 are: New Orleans, La. - 2,882 MW; Memphis, Tenn. - 1,518 MW; Baton Rouge, La. - 1,441 MW, Lake Charles, La. - 837 MW; Monroe, La. - 775 MW; Alexandria, La. - 692 MW; and Hot Springs, Ark. - 622 MW.

Economic Features

Agriculture, including livestock production and dairying, is an important segment of the economy in the market area. There is an abundance of merchantable timber stands throughout the area and significant mineral deposits include oil, natural gas, sand, gravel, clay, bauxite, gypsum, sulphur, salt, lime, and limestone. Principal cities are New Orleans, La; Kansas City, Kan.-Mo.; Oklahoma City, Okla.; Wichita,Kan.; Tulsa, Okla.; Shreveport, La.; Baton Rouge, La.; Jackson, Miss.; Little

Rock, Ark.; Beaumont, Tex.; and Topeka, Kan. A competent network of rail transportation is augmented through access, via barge traffic on the Mississippi and Arkansas Rivers, to the Intracoastal Waterway and its ocean-going commerce.

Petroleum refining has long been a major industry in the area while in recent years, in the vicinity of the Gulf Coast, chemical and petrochemical industries have made a sizeable impact. Other significant industrial pursuits within the market area include, aircraft assembly, processing timber products, food processing, quarrying, and the manufacture of machinery, tools, leather goods, and glass.

The variation of electrical energy requirements per farm customer is closely related to type of farm, productivity of soil, climate, characteristics of the farm population, and cost of competing fuels. In 1970, the energy requirements per customer for farms ranged from 4,750 kWh in PSA 33 to 7,600 kWh in PSA 29. Non-farm residential energy consumption per home ranged from 6,130 kWh in PSA 29 to 8,050 kWh in PSA 35. This category has shown a marked rate of increase in recent years due in part to increased acceptance of air conditioning and heating equipment and to more extensive use of other appliances.

PAST AND ESTIMATED FUTURE POWER NEEDS

Annual Power Needs

The South Central Regional Advisory Committee, composed of representatives from every segment of the electric power industry, in cooperation with the Fort Worth regional office of the Federal Power Commission, has prepared a load forecast to 1990 for use in 1970 National Power Survey. The power market area for the Lower Mississippi Region study is included within the South Central Region of national power studies. The data thus amassed are the basis for the past and future power requirements included in table 2 of this report. This table includes, for each power supply area, actual data for 1950, 1960, and 1970 with projections for 1980 and 1990. Estimates for the entire market area have been trended to 2000 and 2020. Some of the power supply area forecasts are lower than the current forecasts by some of the electric utilities in the area. In other areas the utilities made lower forecasts. This is a natural result in variation of techniques and, in some cases, degrees of optimism.

The peak demand in the market area increased from 3,237 MW in 1950 to 23,258 MW in 1970. Future growth has been projected to require 104,520 MW in 1990 with a trend toward 326,000 MW in 2020. It is noted from table 2 that the annual load factor tended to decrease from 1950 to 1970 but, in view of current trends, is predicted to moderately increase during the next twenty years. This is due in large part to load building activities of the electric utility industry in order to utilize a greater portion of the potential of the installed generating equipment.

The power requirements are developed by classes of sales and combined into a total area requirement and are thus closely related to many of the economic factors of the market area. Projected farm usage is related to trends of cash receipts from marketing, expected trends in numbers of farms, and consideration of types of farms, including commercial farming. Residential usage is closely related to population projections with consideration given to annual energy consumption of appliances, appliance saturation factors, and other home uses of electrical energy.

Area economics, such as income guidelines, provide correlative data in establishing residential growth. Commercial sales projections are mathematically related to population projections and past trends of energy consumption. General area development guides help establish future expected commercialization. Industrial projections are predicated on a judgment basis after careful consideration of the value of mineral products, mineral reserves, value added by manufacture, industrial growth, electric loads as reported by the electric utilities, and the area potential for future industrialization.

Table 2 - Annual Energy for Load, Peak Demands,
and Annual Load Factors in Power Market Area 1/

Power Supply Area	Energy for Load (million kWh)	Peak Demands (MW)	Annual Load Factors (%)	Peak Month	Energy for Load (million kWh)	Peak Demands (MW)	Annual Load Factors (%)	Peak Month
	1950				1980			
25	5,438	995	62.4	Sept.	78,440	16,400	54.6	Aug.
29	1,467	304	55.1	Dec.	14,350	3,250	50.4	July
33	3,846	751	51.2	Aug.	60,080	13,800	49.7	Aug.
34	3,745	726	58.9	Dec.	40,580	8,810	52.4	Aug.
35	2,696	461	66.8	Sept.	64,500	11,240	65.5	Aug.
Market Area	17,192	3,237	60.6	-	257,950	53,500	54.9	-
	1960				1990			
25	13,222	2,688	56.0	July	152,300	31,500	55.2	Aug.
29	3,563	793	51.2	Aug.	25,630	5,760	50.8	July
33	10,456	2,353	50.6	July	116,270	26,600	49.9	Aug.
34	9,540	2,010	54.0	Aug.	76,980	16,410	53.6	Aug.
35	7,949	1,462	61.9	July	141,300	24,250	66.5	Aug.
Market Area	44,730	9,306	54.7	-	512,480	104,520	56.0	-
	1970				2000 2/			
25	35,055	7,083	56.5	Aug.	838,000	168,000	57.0	Aug.
29	7,658	1,763	49.6	Aug.				
33	25,200	5,871	49.0	Aug.				
34	20,185	4,563	50.5	Aug.	2020 2/			
35	22,266	3,978	63.9	Aug.				
					1,715,000	326,000	60.0	Aug.
Market Area	110,364	23,258	54.2	-				

1/ The bulk of the Lower Mississippi Region lies in PSA's 25 and 35. The size of the load in PSA's 25 and 35 is substantially comparable to the load in the Lower Mississippi Region.

2/ Totals for Power Market Area.

Monthly Power Needs

The following table 3 of monthly energy requirements, peak demands, and load factors are for 1970, 1980, and 1990. These figures are helpful in the consideration of seasonal diversity exchanges. Peak demands in the market area for the period of study occurred in the summer months. Forecasts of seasonal load differences are subject to changing load conditions, resulting from temperature-sensitive loads and possible incentive electric rates. Since a considerable portion of the theoretical seasonal difference is applied to maintenance outage scheduling, care must be exercised in providing adequate capacity for maintenance of large high-temperature units, particularly super-critical machines and nuclear-fired units, in the projection of future load differences. In consideration of these factors it is considered that monthly projections beyond 1990 would be of little value.

Table 3 - Monthly Energy for Load, Peak Demands, and Load Factors in Power Market Area (includes Lower Mississippi Region)

Month	Energy for Load (million kWh)	Energy for Load (percent annual)	Peak Demand (megawatts)	Peak Demand (percent annual)	Load Factor (percent)
			1970		
Jan.	8,470	7.7	15,001	64.5	75.9
Feb.	7,608	6.9	14,529	62.5	77.9
Mar.	7,938	7.2	13,954	60.0	76.5
Apr.	8,112	7.4	16,037	69.0	70.3
May	8,826	8.0	17,615	75.7	67.3
June	10,208	9.2	21,835	93.9	64.9
July	11,565	10.5	22,804	98.1	68.1
Aug.	12,151	11.0	23,258	100.0	70.2
Sept.	10,396	9.4	22,226	95.6	65.0
Oct.	8,498	7.7	16,224	69.8	70.4
Nov.	8,107	7.3	15,229	65.5	73.9
Dec.	8,485	7.7	15,237	65.5	74.8
Annual	110,364	100.0	23,258	100.0	54.2
			1980		
Jan.	19,542	7.6	35,221	66.1	74.6
Feb.	17,711	6.9	34,947	65.6	72.8
Mar.	18,993	7.4	34,204	64.2	74.6
Apr.	18,630	7.2	36,210	68.0	71.5
May	21,077	8.2	42,092	79.0	67.3
June	23,232	9.0	48,371	90.8	66.7
July	26,397	10.2	52,171	97.9	68.0
Aug.	26,886	10.4	53,285	100.0	67.8
Sept.	23,377	9.0	49,570	93.0	65.5
Oct.	21,149	8.2	41,141	77.2	69.1
Nov.	20,065	7.8	37,580	70.5	74.2
Dec.	20,891	8.1	37,367	70.1	75.1
Annual	257,950	100.0	53,285	100.0	55.1
			1990		
Jan.	38,758	7.6	68,816	66.1	75.7
Feb.	35,124	6.8	68,278	65.5	76.6
Mar.	37,691	7.4	66,844	64.2	75.8
Apr.	37,017	7.2	70,939	68.1	72.5
May	41,926	8.2	82,448	79.2	68.3
June	46,212	9.0	94,602	90.8	67.8
July	52,442	10.2	101,929	97.9	69.2
Aug.	53,393	10.4	104,115	100.0	68.9
Sept.	46,505	9.1	97,033	93.2	66.6
Oct.	42,067	8.2	80,680	77.5	70.1
Nov.	39,874	7.8	73,536	70.6	75.3
Dec.	41,471	8.1	72,651	69.7	76.7
Annual	512,480	100.0	104,115	100.0	56.2

EXISTING POWER SUPPLY FACILITIES

Power Market Area Power Facilities

Utility Systems

The Southwest Power Pool is a coordinating and reliability group and not an operating pool. Principal members of the pool have contractual arrangements with municipally owned systems, cooperatively owned systems or government owned systems through which all or part of the power supply requirements of such systems are furnished. A number of the member utilities are also members of other similar coordinating pools. The Southwest Power Pool maintains headquarters in Little Rock, Arkansas and member utility systems are as follows:

*Associated Electric Cooperative 1/
*Arkansas Electric Cooperative Corporation
*Arkansas-Missouri Power Company
*Arkansas Power & Light Company 2/ 3/
Board of Public Utilities, Kansas City, Kansas
Central Kansas Power Company, Inc.
*Central Louisiana Electric Company, Inc. (The) 2/
Chanute Municipal Utilities, Chanute, Kansas
City Power & Light Department, Independence, Missouri
City Utilities of Springfield, Missouri
Empire District Electric Company (The) 1/ 2/ 4/
Grand River Dam Authority
*Gulf States Utilities Company 2/
Kansas City Power & Light Company 1/ 4/
Kansas Gas and Electric Company 2/ 4/
Kansas Power & Light Company (The) 4/
*Louisiana Power & Light Company 2/ 3/
*Mississippi Power & Light Company 2/ 3/
Missouri Public Service Company 1/ 2/ 4/
*Missouri Utilities Company
*New Orleans Public Service Inc. 2/ 3/
Oklahoma Gas & Electric Company 2/
Public Service Company of Oklahoma 2/
St. Joseph Light & Power Company
Southwestern Electric Power Company 2/
*Southwestern Power Administration
Western Farmers Electric Cooperative
Western Power Division - CT&U

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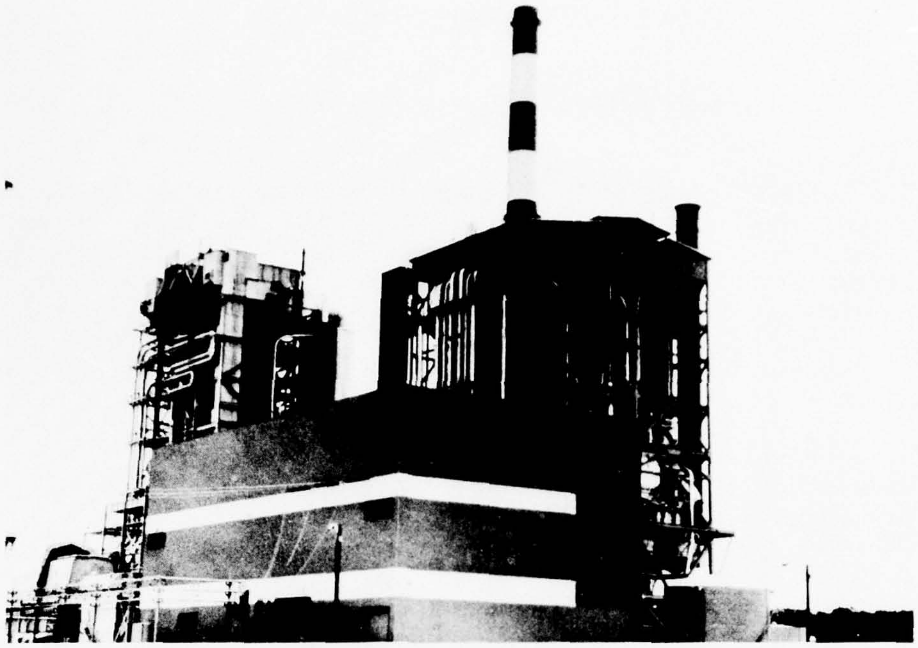
* Operates in Lower Mississippi Region.
1/ Member of Missouri Integration Arrangement (MIA).
2/ Member of South Central Electric Companies (SCEC).
3/ Member of Middle South Utilities.
4/ Member of Missouri-Kansas Pool (MOKAN).

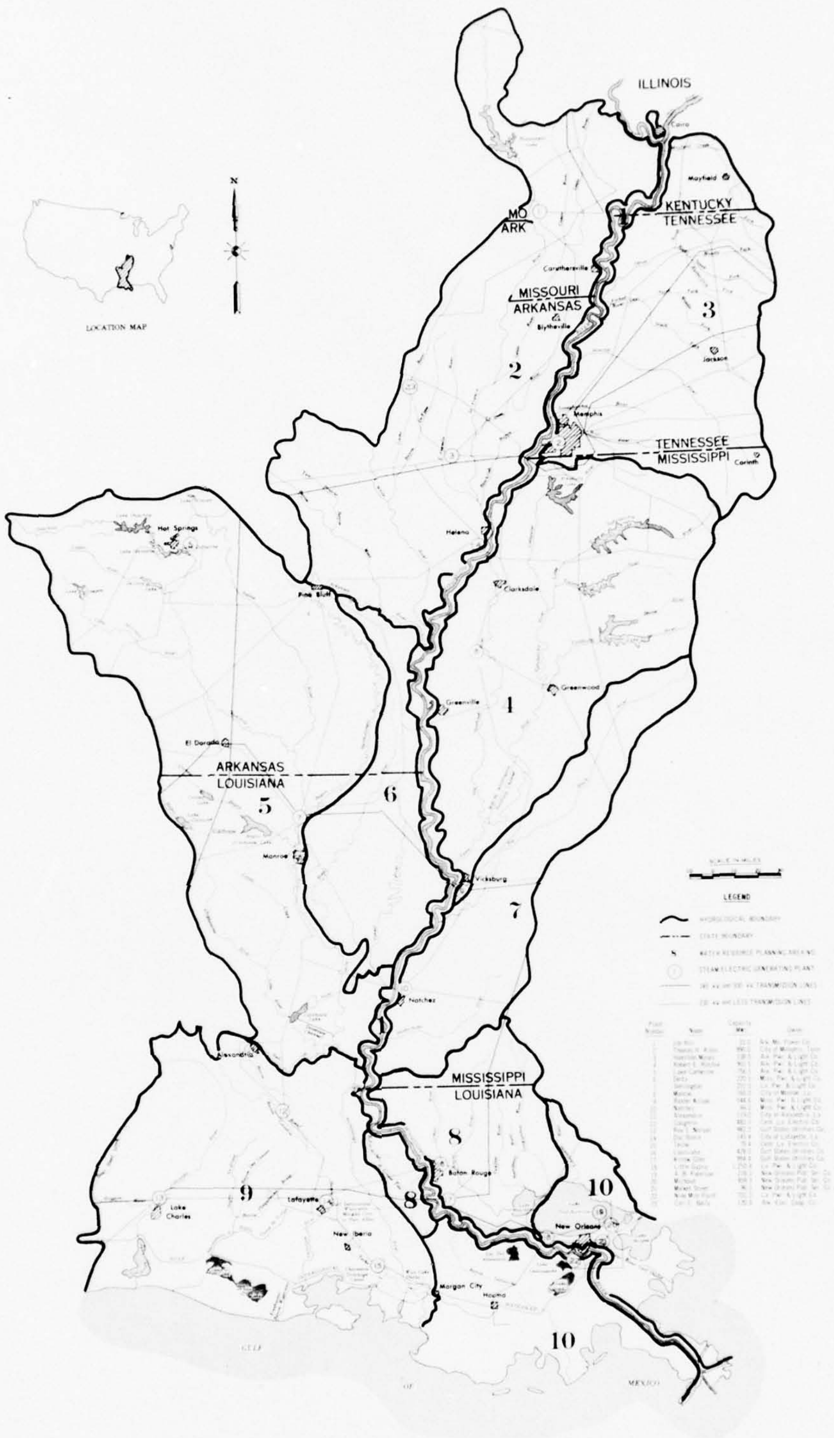


Arkansas Power and Light Company's Robert E. Ritchie steam plant on the Mississippi River.

Principal members of the pool operating within the boundary of the Lower Mississippi Region, see figure 2, Major Steam-electric Generating Plants and Transmission lines - 1970, include Arkansas Electric Co-operative Corporation, Arkansas-Missouri Power Company, Arkansas Power and Light Company, The Central Louisiana Electric Company, Incorporated, Gulf States Utilities Company, Louisiana Power and Light Company, Mississippi Power and Light Company, New Orleans Public Service, Incorporated, and Southwestern Power Administration.

The Southwest Power Pool was organized during World War II by 11 of the present member companies or their predecessors plus one other company which is not now a member. Following termination of the original contract, with the Defense Plant Corporation, in 1946, a new coordination agreement was signed for continuation in a study and planning capacity. On December 17, 1969, a new coordination agreement was signed along the lines of a reliability document, with provision for extended membership, particularly to municipal electric systems. Headquarters are maintained in Little Rock, Arkansas.

The eleven members of the pool comprising the South Central Electric Companies (SCEC) negotiated a seasonal diversity exchange with TVA which began with 435 MW in 1965 and, during the winter of 1970-1971, was increased to 1,500 MW. Additional service schedules under these contracts provide for deferred diversity capacity, firm power purchases, economy energy sales, and emergency service. The intent is to utilize diversity



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

MAJOR STEAM-ELECTRIC GENERATING PLANTS AND TRANSMISSION LINES

FIGURE 2

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to the maximum extent and to take full advantage of the associated Extra High Voltage (EHV) transmission for other system operations savings.

The Missouri-Kansas Pool (MOKAN) is comprised of Kansas City Power and Light Company, Missouri Public Service Company, The Empire District Electric Company, Kansas Gas and Electric Company, The Kansas Power and Light Company, and five satellite members. MOKAN is a formal pooling arrangement whereby large new generating units will be constructed on a participation arrangement and 345-kV transmission will be made possible by the resulting savings. Contractual arrangements between the basic members and the satellite members are pointed toward reducing reserve capacity requirements, exchange of standby service, firm power and economy energy transactions, coordination of load projections, system planning, maintenance scheduling, and spinning reserve supply.

Associated Electric Cooperative, Inc. (an agent for the Missouri Rural Electrification Administration Cooperatives); Kansas City Power and Light Company; Missouri Public Service Company; and The Empire District Electric Company are signatories to the Missouri Integration Arrangement (MIA). The Southwestern Power Administration markets through MIA, 478,000 kW of hydroelectric peaking capacity from White River hydroelectric projects. The arrangement promotes other actions aimed at sharing economies of operations effected through coordinated scheduling.

The transmission network in the market area is dominated by the recently-constructed 345-500-kV SCEC grid, developed to accommodate the SCEC-TVA 1,500-MW seasonal diversity exchange. The MOKAN Pool has additional 345-kV lines connecting north of the SCEC grid. The 500-kV lines traverse the Lower Mississippi Region at several points. In addition, the market area has a considerable grid of 69-, 115-, 138-, 161-, and 230-kV transmission lines.

The installed and dependable capacity of electric utility generating plants in service in the power market area as of December 31, 1970, are shown in the following table 4.

Table 4 - Installed and Dependable Capacity of Utility Generating Plants in Power Market Area - December 31, 1970

Power Supply Area	Gas Turbine	Hydro	Steam	Internal Combustion	Total
		INSTALLED CAPACITY - (kilowatts)			
25	237,300	883,340	7,269,516	248,743	8,638,899
29	47,570	1,850	1,413,210	321,367	1,783,997
33	155,660	724,000	5,189,559	164,660	6,233,879
34	107,272	220,600	5,373,690	176,387	5,877,949
35	0	132,000	5,184,011	123,050	5,439,061
	547,802	1,961,790	24,429,986	1,034,207	27,973,785
		DEPENDABLE CAPACITY - (kilowatts)			
25	229,950	881,000	7,104,369	230,728	8,449,047
29	44,650	1,850	1,529,712	301,781	1,877,993
33	152,450	707,500	5,220,300	151,153	6,231,403
34	98,500	220,140	5,359,225	168,210	5,846,075
35	0	129,000	5,002,954	108,848	5,240,802
	525,550	1,939,490	24,216,560	960,720	27,645,320
1/	476,600	165,800	10,748,438	259,431	11,650,269
2/	476,150	162,000	10,532,773	236,663	11,407,586

1/ Installed capacity in Lower Mississippi Region.
2/ Dependable capacity in Lower Mississippi Region.

Large conventional outdoor gas-fired steam-electric generating units are the principal power supply in the area although the use of coal is increasing in Missouri, eastern Kansas, and northeastern Arkansas. First nuclear generation is scheduled in the market area by late 1973 and in the Lower Mississippi Region by 1977 by Louisiana Power and Light Company.

Industrial Plants

Industry-owned generation is not a part of the public power supply as furnished by the electric utility industry but, in projecting future electric utility load levels, consideration is given to utility systems having to meet this load in the event industry-owned generation be discontinued. A large number of industries in the area own and operate their own generating plants. Statistics for these plants are not generally as complete as those for the utility systems' plants but do reflect moderate increases in industry-owned generation. Available data indicate

that the approximate installed capacity for industry-owned generation in the market area as of December 31, 1970, was 2,112 MW of steam-electric capacity, and 233 MW of diesel-electric capacity for a total of 2,345 MW. Total generation during 1970 was approximately 16,737 million kWh.

The Kaiser Aluminum Company's primary aluminum reduction plant at Chalmette in Saint Bernard Parish, Louisiana, is the largest industry-owned plant in the area with installed capacity of 398,000 kW steam and 103,200 kW diesel. The 1970 generation at this plant was 4,145 million kWh.

Dow Chemical Company operates a steam plant with 221,700 kW installed capacity in the Baton Rouge area. Pittsburgh Plate Glass Company has two plants near Lake Charles with installed capacity of 166,180 kW and 90,000 kW, respectively. Largest industry-owned plant in Arkansas is the Pine Bluff plant of International Paper Company with installed capacity of 97,880 kW.

Other industry-owned generating plants throughout the area are allied with the pulp and paper industry, refineries, alumina plants, wood products manufacture, chemicals, and the production of sulphur, sugar, salt, cement, and lime.

Interarea Transfers

The largest interarea transfer in the market area is the seasonal diversity exchange between the South Central Electric Companies (SCEC) and the Tennessee Valley Authority (TVA). The seasonal air conditioning loads of the SCEC utilities create a decided summer peak while the TVA market area, influenced primarily by electric heating, experiences high winter peak loads. The exchange, which reached a total of 1,500 MW in 1970, can be increased if seasonal load differences grow.

Other interarea exchanges resulting from the MOKAN and MIA pools and those involving the Southwestern Power Administration system are described in the section, Marketing to Southwestern Power Administration Preference Customers System.

Scheduled Additions

Extensive and adequate advance planning is essential for meeting in the most economical manner the rapidly growing future requirement for electric power. In planning for future coordination in the Southwest Power Pool (SWPP) area, the major systems will be interdependent on other systems within sub-areas of the SWPP area but capable of providing reliable electric service when separated from other areas. Governed by economics, increasing power demands, and a decrease in adequate plant sites, there has been a trend toward developing larger units. In addition to these factors, skepticism over future fuel supply has prompted the introduction of nuclear generation into future planning for this area.

Arkansas Power and Light Company's Nuclear No. 1 on Dardanelle Reservoir to be completed September 1973.

Listed below in table 5 arranged according to the Power Supply Area in which physically located are known units (300 MW or larger) which are being planned in the SWPP area:

Table 5 - Major Scheduled Additions to Fuel-Electric Generating Capacity in Southwest Power Pool Area

Power Supply Area	Utility	Plant	Installed Capacity (megawatts)	Date in Service
25	Louisiana Power & Light	1/ Nine Mile Point #4	783 2/	5/71
25	Miss. Power & Light	1/ Baxter Wilson #2	781 2/	9/71
25	City of New Madrid, Mo. 6/	1/ New Madrid #1	600	7/72
25	Louisiana Power & Light	1/ Nine Mile Point #5	783	3/73
25	Arkansas Power & Light	Ark. Nuclear One	793 3/	9/73
25	Louisiana Power & Light	1/ Waterford #1	430	3/74
25	Miss. Power & Light	1/ Gerald Andrus #1	781	1/75
25	Louisiana Power & Light	1/ Waterford #2	430	1/75
25	Arkansas Power & Light	Ark. Nuclear Two	950 3/	12/75
25	Louisiana Power & Light	1/ Waterford #3	1,165 3/	1/77
25	Associated Elec. Coop.	1/ New Madrid #2	600	1977
25	Middle South Utilities	1/ 4/	420	1978
25	Miss. Power & Light	1/ Grand Gulf Nuclear Sta.	1,250 3/	1/79
25	Middle South Utilities	1/ 4/	1,250 3/	1980
33	Southwestern Elec. Power	Wilkes #3	345 2/	12/71
33	Oklahoma Gas & Electric	Seminole #2	567	2/73
33	Southwestern Elec. Power	Knox Lee #5	345	2/74
33	Public Service of Okla.	Riverside #1	450	4/74
33	Oklahoma Gas & Electric	Seminole #3	567	2/75
33	Public Service of Okla.	Riverside #2	450	4/76
34	Kansas Gas & Electric 5/	La Cygne #1	820	4/73
34	Kansas Gas & Electric 5/	La Cygne #2	600	1977
35	Central La. Electric	1/ Teche #3	348 2/	5/71
35	Gulf States Utilities	1/ Willow Glen #4	595	4/73
35	Gulf States Utilities	Sabine #4	595	9/73
35	Gulf States Utilities	1/ Willow Glen #5	580	9/75
35	Central La. Electric	Rodemacher #1	446	1/75
35	Gulf States Utilities	Sabine #5	480	9/76
35	Gulf States Utilities	Sabine #6	480	9/77
35	Central La. Electric	Rodemacher #2	550	1978
35	Gulf States Utilities	1/ Willow Glen #6	480	9/78
35	Gulf States Utilities	1/ Willow Glen #7	480	4/79
35	Gulf States Utilities	1/ River Bend Sta. #1	900 3/	1979

1/ Located in Lower Mississippi Region. For details including water use see Appendix T, Plan Formulation.
2/ In service.
3/ Nuclear plant.
4/ Name not assigned.
5/ Joint venture with Kansas City Power and Light Company.
6/ Operated by Associated Electric Cooperative.

Projects in Lower Mississippi Region

On December 31, 1970 there were 28 on-the-line hydroelectric plants in the market area with combined dependable capacity of 1,939,500 kilowatts. Four of these plants, with combined dependable capacity of 162,000 kilowatts, are located in the Lower Mississippi Region and are listed in table 6. Their locations are shown on figure 3.

Table 6 - Existing Hydroelectric Plants in Lower Mississippi Region - December 31, 1970

Plant	Stream	State	Installed Capacity (MW)	Dependable Capacity (MW)	Minimum Annual Energy (GWh)
Blakely Mountain	Ouachita R.	Ark.	75.0	75.0	139.2
Carpenter	Ouachita R.	Ark.	56.0	56.0	76.6
Remmel	Ouachita R.	Ark.	9.3	10.0	43.0
Narrows	Little Mo. R.	Ark.	25.5	21.0	18.4
Total			165.8	162.0	277.2

Two of these are federal projects, constructed by the Corps of Engineers and operated as follows:

(1) Blakely Mountain, on the Ouachita River, with installed and dependable capacity of 75.0 MW in two 37.5-MW units, began commercial production of power in 1955. The power plant is operated under loading instructions from the Arkansas Power and Light Company. By contract with the Southwestern Power Administration (SPA), the company schedules generation from the plant as needed for its system and in return the SPA withdraws a contractually specified amount of power from the company's system at other points.

(2) Narrows, on the Little Missouri River, has installed capacity of 25.5 MW in three 8.5-MW units and combined dependable of 21.0 MW. Two units were put into service in 1950 and the third unit went on-the-line in 1969. The power plant is operated in accordance with loading instructions from the Southwestern Electric Power Company arranged contractually by the SPA.

The Carpenter and Remmel plants are tandem plants, on the Ouachita River, owned and operated by the Arkansas Power and Light Company and licensed by the Federal Power Commission as project No. 271.

The Remmel plant was completed in 1924 with three units and total dependable capacity of 10.0 MW. There are provisions for two additional units. The Carpenter plant was completed in 1932 with dependable capacity of 56.0 MW in two 28.0-MW units. Space is provided for an additional unit. The plants are operated by the Company as part of the interconnected system of the Middle South Utilities.

Section 10(f) of the Federal Power Act, as amended, provides that if the owner of any power project is directly benefited by a storage reservoir or other headwater improvement of the United States, or of another licensee, that the Commission shall apportion charges for "interest, depreciation, and maintenance" of the upstream project as the Commission considers equitable. By order of December 20, 1963 the Commission, based on staff studies, determined that the Blakely Mountain project provides benefits to the downstream Carpenter and Remmel plants of Arkansas Power and Light Company, valued at $69,360 annually.

One hydroelectric project was under construction in the Lower Mississippi Region at the end of 1970. This is the De Gray project on the Caddo River in Arkansas which went into service in January 1972 for which data are listed in table 7.

Table 7 - Hydroelectric Plant Under Construction in the Lower Mississippi Region - December 31, 1970

Plant	Stream	State	Installed Capacity (MW)	Dependable Capacity (MW)	Minimum Annual Energy (GWh)
De Gray	Caddo R.	Ark.	68.0 1/	68.0 1/	60.4

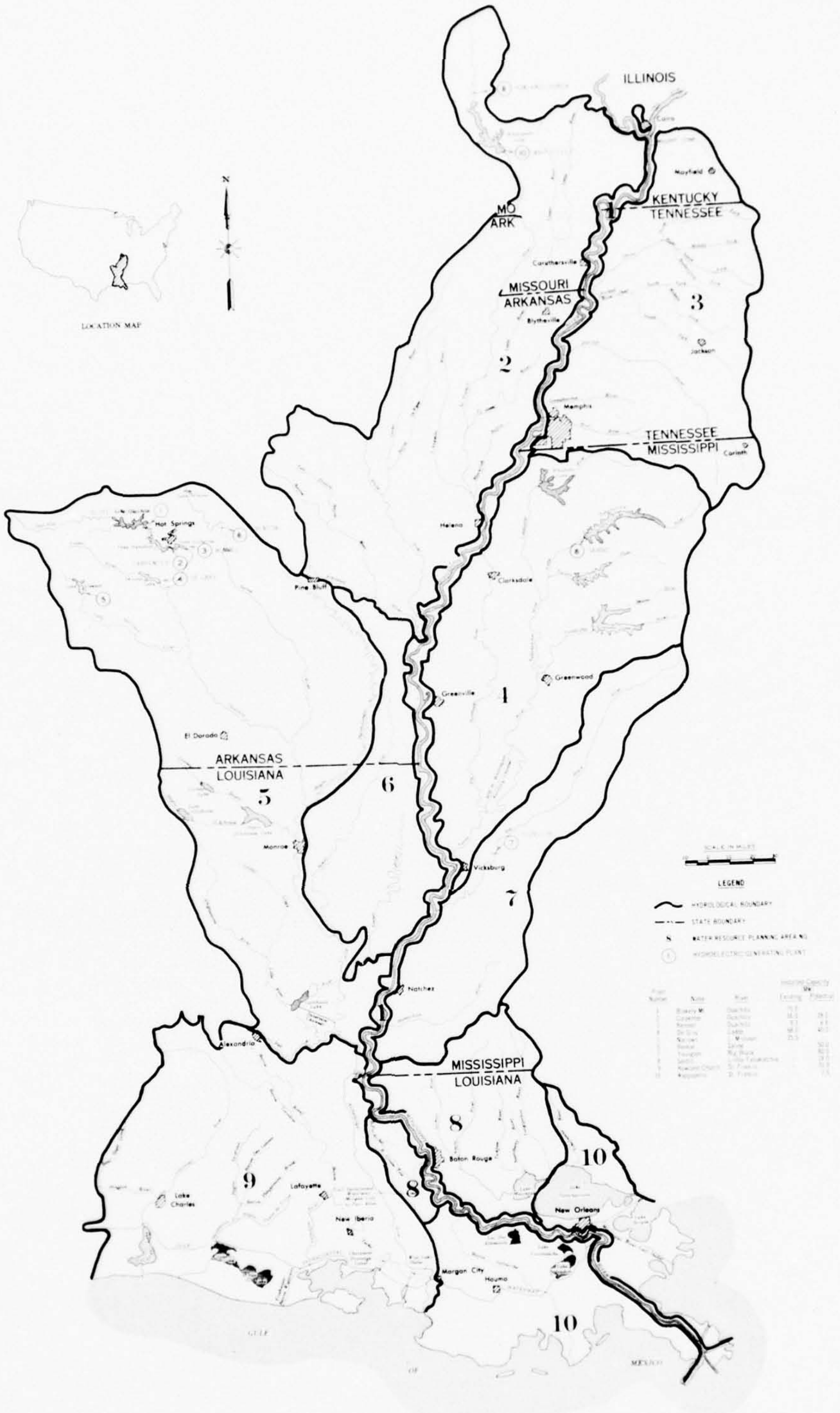
1/ One conventional unit @ 40.0 MW, one reversible unit @ 28.0 MW.

Eight sites for potential hydroelectric power development in the Lower Mississippi Region are listed in table 8 and the locations are indicated on figure 3.

Table 8 - Potential Hydroelectric Plant Capacity in Lower Mississippi Region

Project	Stream	State	Installed Capacity (MW)
Rowland Church	St. Francis R.	Mo.	70.0
Wappapello	St. Francis R.	Mo.	7.5 1/
Sardis	Little Tallahatchie R.	Miss.	18.0 1/
Youngton	Big Black R.	Miss.	80.0
Carpenter	Ouachita R.	Ark.	28.0 2/
Remmel	Ouachita R.	Ark.	6.6 2/
De Gray	Caddo R.	Ark.	40.0 1/
Benton	Saline R.	Ark.	50.0

1/ Addition to an existing project.
2/ Addition to existing Licensed Project No. 271. Study of redevelopment of this project is being made by owner.



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

EXISTING HYDROELECTRIC PROJECTS AND POTENTIAL DEVELOPMENTS

FIGURE 3

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Projects in Other Basins in Power Market Area

The 24 existing hydroelectric projects in the power market area, which are outside the Lower Mississippi Region, are listed with some of their pertinent data in table 9:

Table 9 - Existing Hydroelectric Projects in Power Market Area, Outside Lower Mississippi Region - December 31, 1970

Plant	Stream	State	Installed Capacity (MW)	Dependable Capacity (MW)	Minimum 5/ Annual Energy (GWh)
Beaver 1/	White R.	Ark.	112.0	112.0	86.0
Table Rock 1/	White R.	Mo.	200.0	200.0	245.0
Ozark Beach 2/	White R.	Mo.	16.0	16.0	61.1 6/
Bull Shoals 1/	White R.	Ark.	340.0	340.0	352.0
Norfork 1/	White R.	Ark.	70.0	70.0	105.0
Greers Ferry 1/	White R.	Ark.	96.0	93.0	101.0
Keystone 1/	Arkansas R.	Okla.	70.0	72.0	44.5
Pensacola 2/	Grand R.	Okla.	86.4	86.4	68.8
Salina 2/3/	Saline Cr.	Okla.	130.0	130.0	250.0
Markham Ferry 2/	Grand R.	Okla.	108.0	108.0	36.6
Fort Gibson 1/	Grand R.	Okla.	45.0	45.0	44.1
Tenkiller Ferry 1/	Illinois R.	Okla.	34.0	34.0	41.6
Eufaula 1/	Canadian R.	Okla.	90.0	90.0	79.5
Dardanelle 1/	Arkansas R.	Ark.	124.0	124.0	164.0
Denison 1/	Red R.	Okla.-Tex.	35.0 4/	35.0 4/	70.5
Broken Bow 1/	Mountain Cr.	Okla.	100.0	86.0	74.5
Toledo Bend 2/	Sabine R.	La.-Tex.	80.0	80.0	65.7
Sam Rayburn 1/	Angelina R.	Tex.	52.0	49.0	50.3
Six Minor Plants	-	-	7.6	7.1	- 7/
Total			1,796.0	1,777.5	1,940.2

1/ Federal plant.
2/ Operates under FPC license.
3/ Pumped-storage.
4/ One-half of total listed. Other one-half contracted to another market area.
5/ Based on 1951-1957 critical period for Arkansas-White-Red system except as noted.
6/ Based on FPC staff studies for calendar year 1954.
7/ Not available.

A portion of the generation from these plants is marketed in the Lower Mississippi Region through contractual arrangements made by the Southwestern Power Administration, marketing agent for the Federal projects in the power market area.

There are an additional seven hydroelectric power plants under construction or definitely proposed within the designated power market area. All these projects are scheduled to be in-service by 1980. These plants are listed, with some of their pertinent data, in table 10:

Table 10 - Hydroelectric Projects Under Construction or Scheduled in Power Market Area 1/ - December 31, 1970

Plant	Stream	State	Installed Capacity (MW)	Dependable Capacity (MW)	Minimum 2/ Annual Energy (GWh)
Harry S. Truman 3/	Osage R.	Mo.	160.0	160.0	280.3 5/
Stockton	Sac R.	Mo.	45.2	43.6	54.2 6/
Norfork	North Fork R.	Ark.	85.0 4/	85.0 4/	-7.0 4/7/
Salina 3/	Saline Cr.	Okla.	390.0 4/	390.0 4/	750.0 4/
Webbers Falls	Arkansas R.	Okla.	66.0	66.0	42.7
Robert S. Kerr	Arkansas R.	Okla.	110.0	110.0	85.0
Ozark	Arkansas R.	Ark.	100.0	100.0	72.4
Total			956.2	954.6	1,277.6

1/ These projects all scheduled to be in-service by 1980.
2/ For 1951-1957 period except as noted.
3/ Pumped-storage.
4/ Addition to existing plant.
5/ 20 percent annual load factor.
6/ Assumed minimum 1,200 hours annual operation.
7/ Based on FPC staff studies for calendar year 1954.

Summary of Hydroelectric Projects in Power Market Area

Dependable hydroelectric capacity existing in the designated power market area totaled 1,939.5 megawatts on December 31, 1970. This includes 162.0 megawatts located within the Lower Mississippi Region.

There is under construction, and scheduled, an additional 1,022.6 megawatts to be in-service by 1980. This includes 68.0 megawatts in the Lower Mississippi Region. At that time, end of 1980, there will be total dependable hydroelectric capacity in the power market area of 2,962.1 megawatts. There is no firm plan for additions beyond 1980.

NEED AND UTILIZATION OF ADDITIONAL CAPACITY

Additional Capacity Required in Market Area

Load forecasts and projected patterns of generation for the power market area were established during studies to up-date the Federal Power Commission's National Power Survey and are included in the report of the South Central Regional Advisory Committee dated February 1969. An exception, included in the following table 11. is that actual 1970 data have become available and have been substituted for the estimates used in the cited report of the South Central Regional Advisory Committee.

Table 11 - Capacity and Load Balance in Power Market Area

	1970	1980 (megawatts)	1990
Peak Demand	23,258	53,500	114,149 1/
Reserve Requirement	3,489	8,025	17,122
Total Capacity Required	26,747	61,525	131,271
Existing Capacity	27,645	27,645	64,739
Scheduled Additions	-	37,720	75,527
Less Estimated Retirements	-	626	9,631
Available Capacity in Market Area	27,645	64,739	130,635
Firm Power Imports	1,606	1,736	2,022
Total Capacity Available	29,251	66,475	132,657
Excess Capacity Available	2,504	4,950	1,386

1/ Includes higher load data as requested by Gulf States Utilities Company for PSA 35 in 1990.

The above table indicates that estimated capacity will exceed projected demand by a comfortable margin in 1980 but by considerably less margin in 1990. This is to be expected since the data sources for planning generation patterns tend to be specific for six to eight years into the future, and more general in nature for the latter years. The nature of future loads indicates that any feasible conventional hydroelectric power and substantial quantities of pumped storage capacity can be marketed in the power market area.

Estimated Future Load Shapes

Figures 4 and 5 indicate the possible operation of hydroelectric resources on the estimated load shapes for the peak month in the power market area in 1980 and 1990. The De Gray hydro project, a combination of one conventional unit and one reversible unit, was placed on the load separately because it is located in the Lower Mississippi Region. Grand River Dam Authority's Salina project was loaded separately because it is the only existing pumped-storage site connected to the load of the power market area.

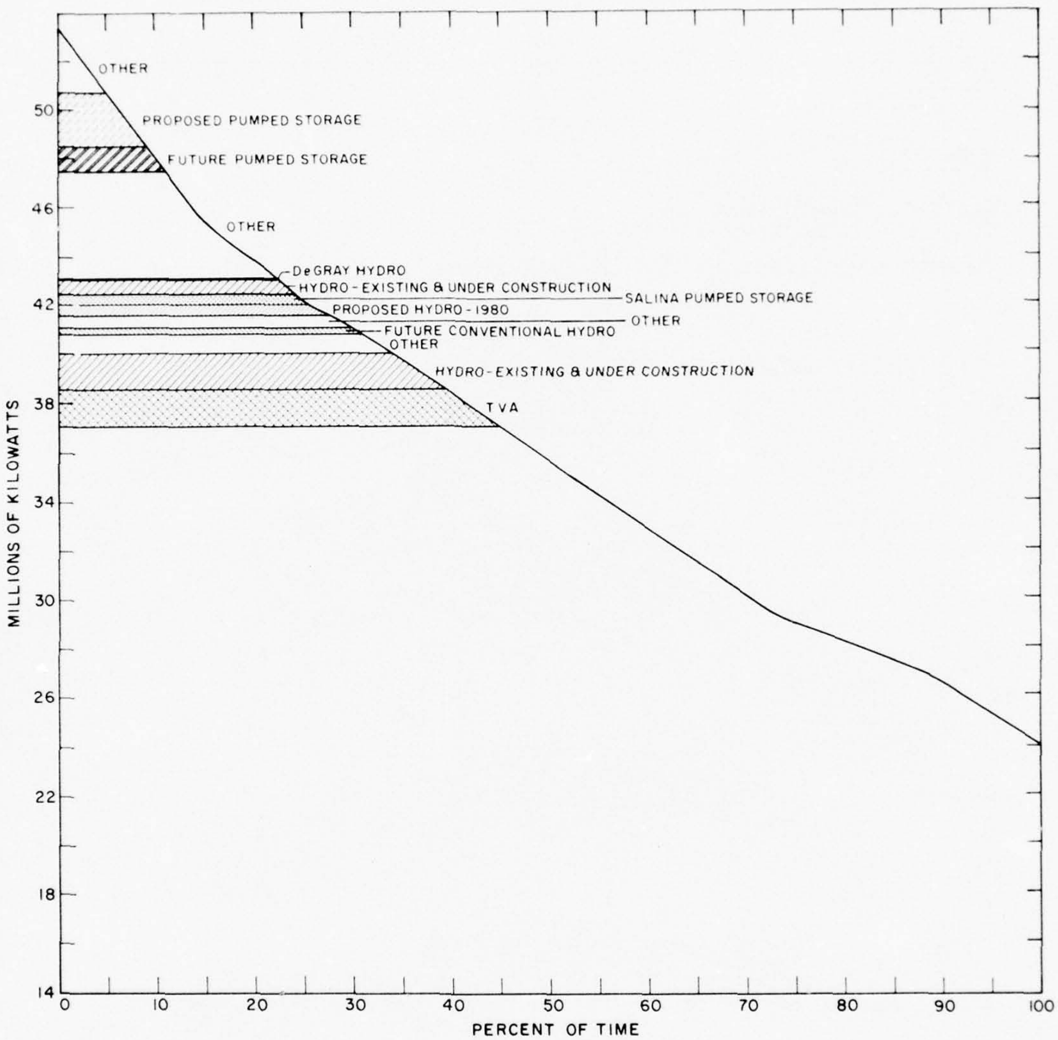
Figures 6 and 7 indicate the projection of normal projected weekly load shape for the peak week in 1980 and in 1990. It is indicated that, in general, forebays of pumped-storage developments can be recharged by pumping during the eight hours after midnight, Tuesday through Friday, and part of Saturday morning. Based on historical experience there could be a heat storm which would produce one or more periods of five successive days with essentially the same peak load each day. This has resulted in a general requirement of the equivalent of 16 hours storage of full load generation. The pumping schedule for a five-day peak of this type is illustrated in figure 8.

Load shapes for the Lower Mississippi Region would be similar to those developed for the power market area.

Hydro-Thermal System Coordination

Hydroelectric peaking power projects, pumped-storage projects, and seasonal diversity power interchanges must be coordinated with thermal resources if they are to be a dependable source of power in the market area. The combined hydro-thermal system must plan to use hydro capacity with its limited firm energy to supply annual peak loads, if it is to be a reliable and valuable power supply component. Thermal power and energy are used to supply the remainder of the load, but in good water years advantageous fuel savings may be attained by using the excess hydro energy.

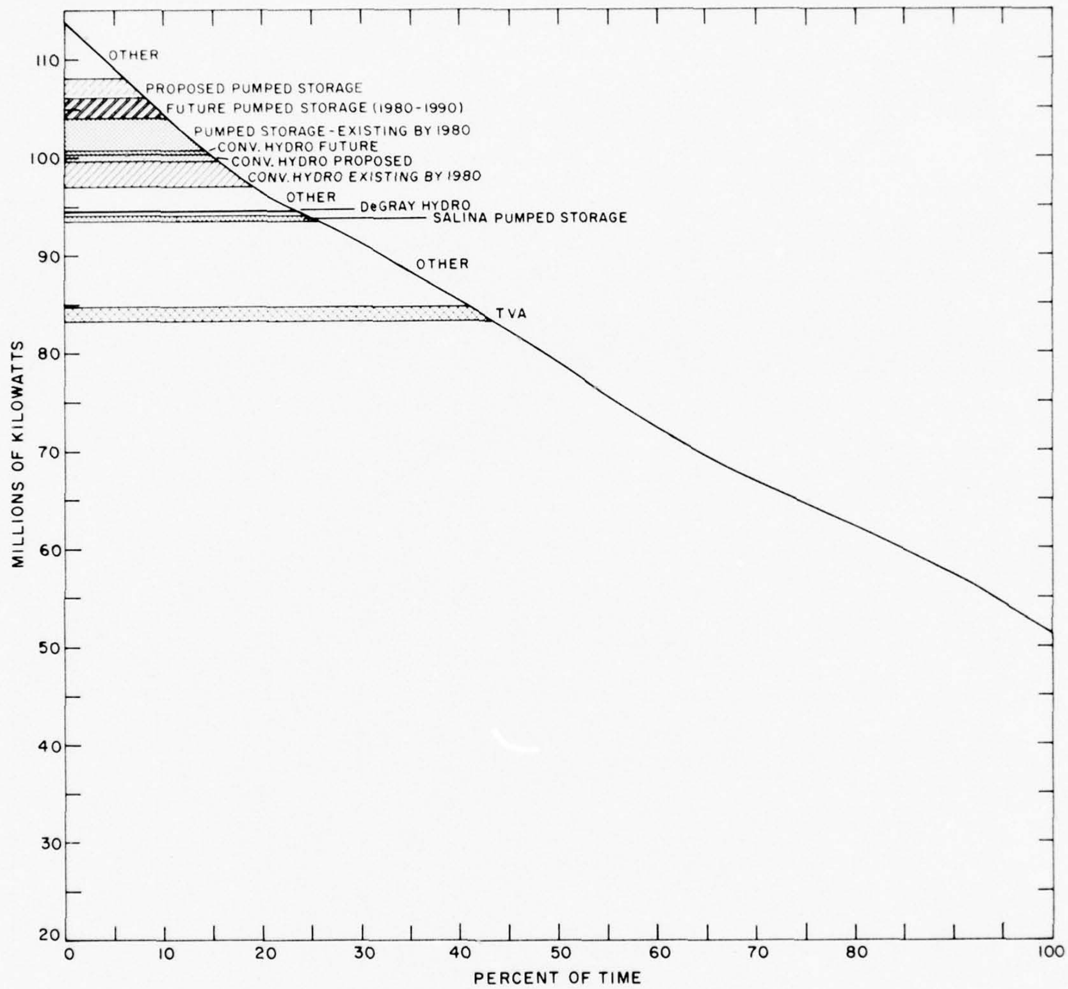
LOAD DURATION CURVE
PEAK MONTH 1980
PSA 25,29,33,34,35



Note:
A load duration curve for the Lower Mississippi Region would have the same general shape and relative loading as shown. A curve for the smaller area was not developed, however, because any future hydroelectric power installation would not be marketed only in the Lower Mississippi Region but on a power supply area basis.

FIGURE 4

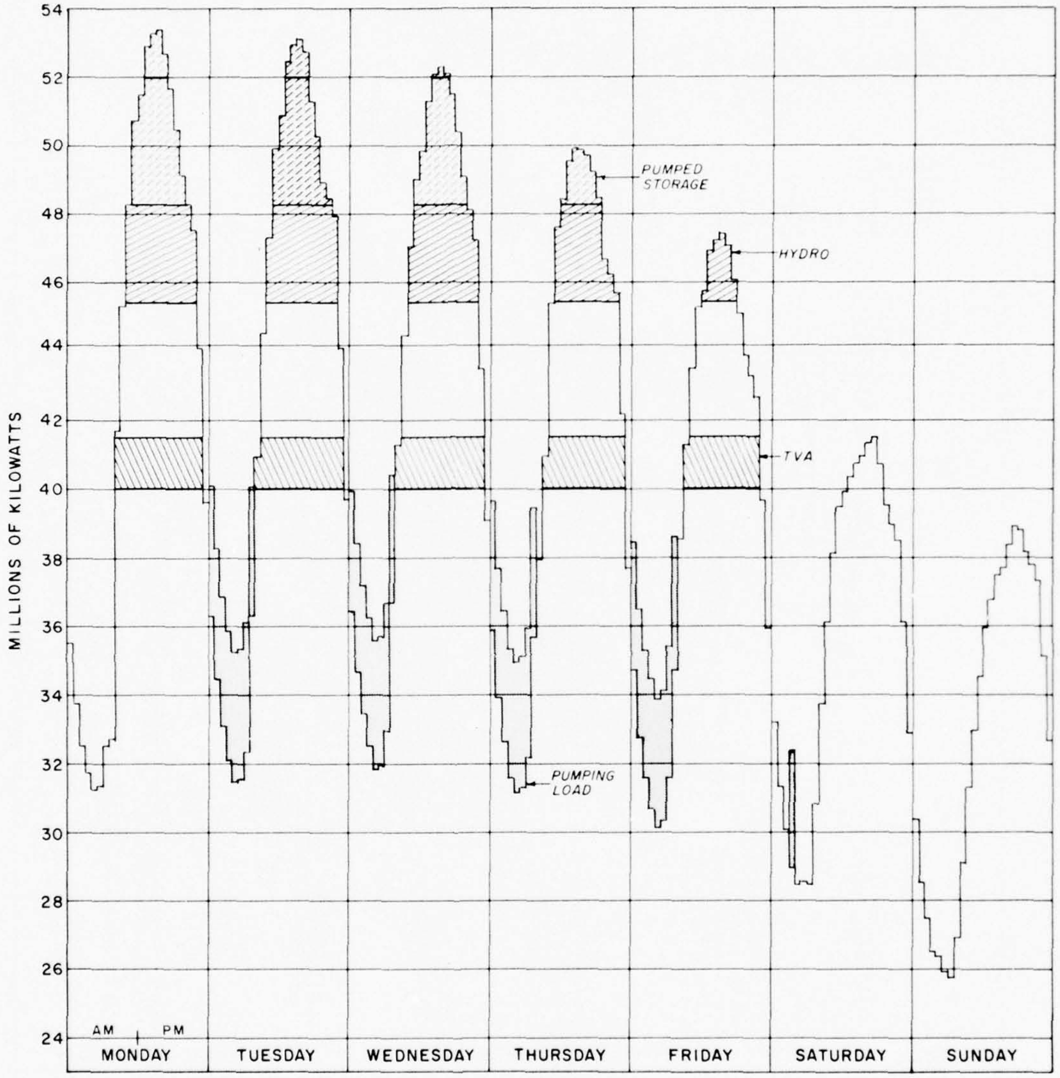
LOAD DURATION CURVE
PEAK MONTH 1990
PSA 25,29,33,34,35



Note:
A load duration curve for the Lower Mississippi Region would have the same general shape and relative loading as shown. A curve for the smaller area was not developed, however, because any future hydroelectric power installation would not be marketed only in the Lower Mississippi Region but on a power supply area basis.

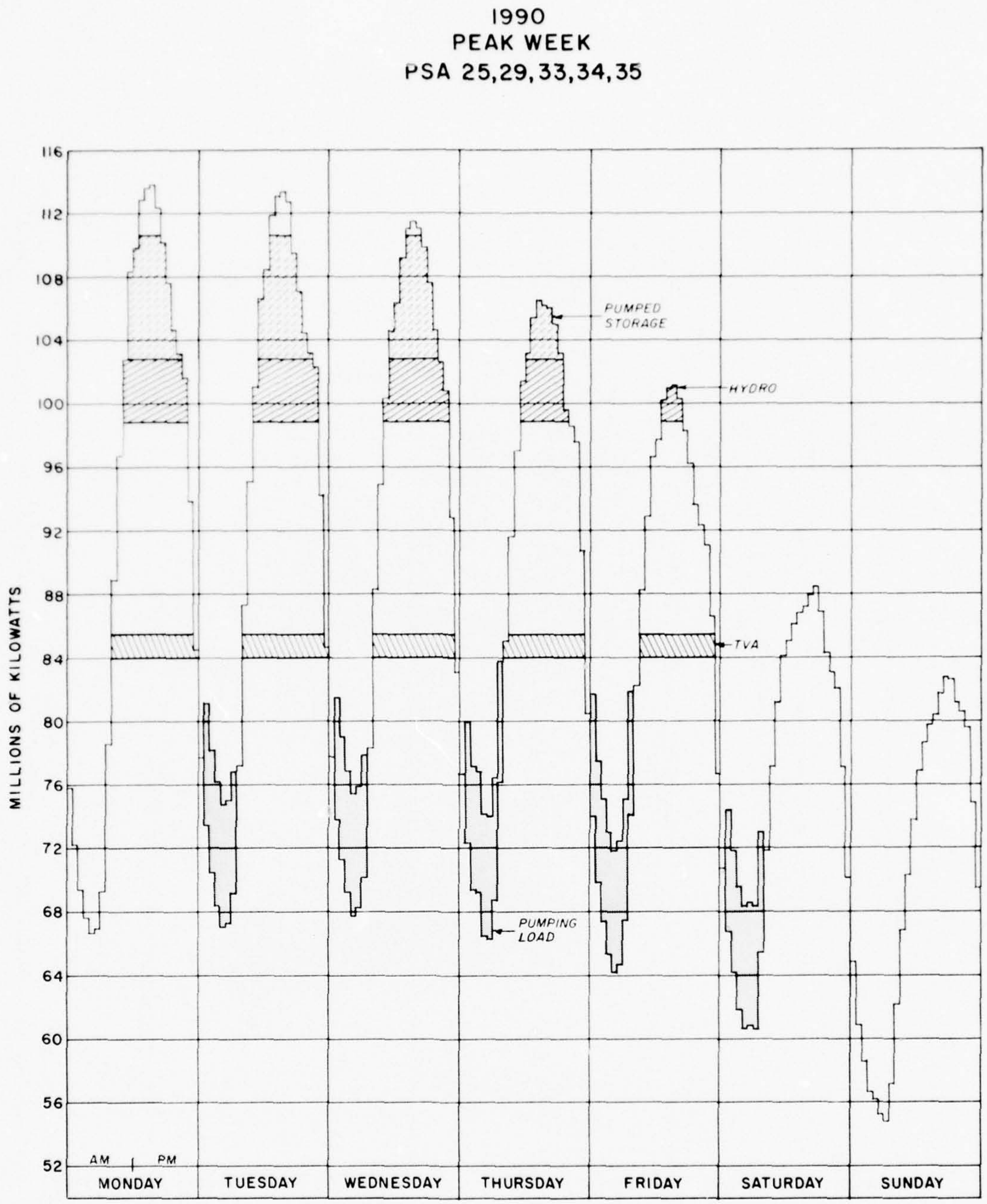
FIGURE 5

1980
PEAK WEEK
PSA 25,29,33,34,35



Note:
A weekly load shape for the Lower Mississippi Region would have the same general shape and relative loading as shown. A chart for the smaller area was not developed, however, because any future hydroelectric power installation would not be marketed only in the Lower Mississippi Region but on a power supply area basis.

FIGURE 6



Note:
A weekly load shape for the Lower Mississippi Region would have the same general shape and relative loading as shown. A chart for the smaller area was not developed, however, because any future hydroelectric power installation would not be marketed only in the Lower Mississippi Region but on a power supply area basis.

FIGURE 7

ESTIMATED PUMPING SCHEDULE FOR PEAK DAY
OCCURRING FIVE CONSECUTIVE DAYS
1980
PSA 25,29,33,34,35

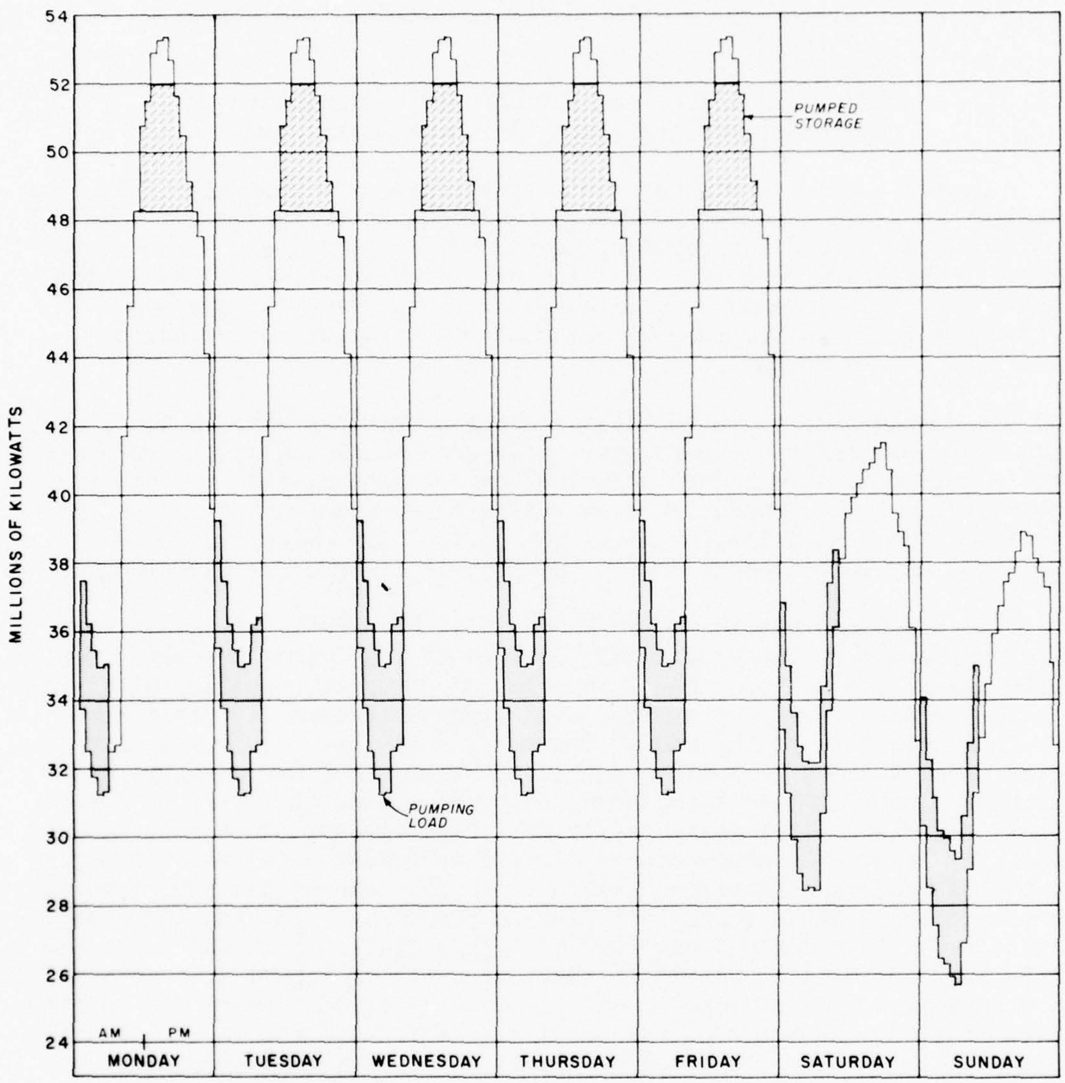


FIGURE 8

Hydroelectric Capacity Utilization

The Hydro Utilization Subcommittee of the South Central Regional Advisory Committee in up-dating the National Power Survey made a study of the hydroelectric potential of the region. It was concluded that the conventional and pumped-storage hydroelectric capacity expected to be available in 1980 and 1990 can be utilized satisfactorily on the load as demonstrated on the previously referenced load shapes.

Summary of Future Loads Which Could be Supplied by Hydroelectric Generation in Power Market Area

Hydroelectric plants have some advantages over thermal plants. The ability to start quickly and change power output rapidly makes them particularly suited for carrying peak loads and supplying spinning reserve. They have long life and slow depreciation with relatively low operation and maintenance costs, with less down time for overhaul. These plants do not consume water, contribute to air pollution, or add heat to the streams.

A pumped-storage installation, where a suitable site is available, can serve two desirable purposes. Off-peak load is furnished for thermal plants to assure a more efficient operation and, peaking load is made available by generation from water stored with this off-peak generation. These installations will be particularly effective when available for use in conjunction with the projected large nuclear plants.

As discussed herein and in Appendix T, Plan Formulation, in applying hydroelectric capacity to the peak month load duration curves for 1980 and 1990, figures 4 and 5, a selected group of potential sites in the power market area were used, with dependable capacity considered as that available at the end of September during the minimum energy year. For various reasons, a number of these sites may never be developed. On the other hand, some sites not listed may later be developed. To allow for possible additional developments there was added to the 1980 load, 1000 megawatts of "future pumped-storage" and 250 megawatts of "future conventional hydro". In like manner the 1990 load was increased by 2,000 megawatts of "future pumped-storage" and 500 megawatts of "future conventional hydro". This assures that the projected 1980 load can utilize satisfactorily, as shown on figure 4, about 500 megawatts of the proposed and future conventional hydro and in excess of 3,000 megawatts of pumped-storage which are not in the planning stage at this time. As shown on figure 5 the projected 1990 load can use approximately an additional 1,000 megawatts of the proposed and future conventional hydro and about 4,000 megawatts of pumped-storage.

Environmental Considerations for Electric Power

General

In recent years concern for the quality of the environment has emerged as a major factor in the planning of electric power facilities to meet the Nation's growing energy demands. The traditional attitude of providing electrical power at the lowest possible cost has been replaced with a new social concern which commands adaptation of our energy sources to the environment.

Because it is our most universal energy form, electrical energy production has a major environmental impact on air, land and water resources. The principles of production demand the discharge of effluents into the atmosphere and into water bodies; require vast quantities of fuel and water; and demand the utilization of land resources for plant sites and transmission line right-of-way. It is small wonder then, that an industry which crosses so many boundaries, would come under environmental criticism. The challenges involved in continuing to provide dependable, adequate, and reliable supplies of electrical energy, where and when it is needed, strain the current state of the art of our technological capacity.

Impact on Water Resources

At present, all major sources of electric power generation need water to function. Steam plants require water for boiler use and for cooling. Hydroelectric plants require the mechanical energy derived from falling water. It is largely because of this water dependence that the electric power industry has come under attack by environmental interests.

The basic operation of a thermal-electric plant requires that heat be rejected by the condensers. Water provides the cooling medium and it, in turn rejects heat to the atmosphere by evaporation from cooling towers or cooling ponds. The cooling pond concept includes lakes, rivers or, in coastal regions, salt water bays and estuaries, some of which provide once-through condenser cooling with little or no recirculation.

Marine biologists say that the dispersion of large heat loads to these bodies of water will upset the aquatic ecosystem. Each aquatic species adapts to the seasonal variations in temperature of the water in which it lives, but it cannot adjust to the shock of abnormally abrupt change. The temperature of the water has pronounced effects on the appetite, digestion and growth of fish, varying with each species. Temperature increase speeds the rate of metabolism, increasing respiratory stress on the organism. Experiments show also that temperature plays a critical role in the reproduction of aquatic animals. There are critical temperatures above or below at which fish will not reproduce. Thus, an ecological system in dynamic balance demands temperature variations favorable for all the components, including plants and crustaceans.

Promise is shown for the utilization of this waste heat for commercial purposes, however, most schemes are not as yet practical. These include utilization of this heat to heat buildings, or for farm irrigation to improve crop production. More promising is the idea of using waste heat in desalination plants to aid in the evaporation process. Consideration is being given to utilizing waste heat to improve the efficiency of sewage treatment. Strides are being made in the area of sea farming, and indications are that heated water improves the growth rate of certain species of fish and shellfish. All of these ideas depict progress, however, at present the bulk of the waste heat from power plants will continue to be disposed to the environment.

Other water pollution problems result from the discharge of chemicals and suspended matter associated with the generation of electricity. Included are slag and ash disposal, station waste, run-off from station properties, and disposal of material collected on filters.

Hydroelectric installations, considered to be the cleanest method for producing electric power, raise additional environmental questions. Hydro generation must have a firm water supply and therefore normally requires storage, resulting in evaporative losses and possible water quality impairment. Impounded water has a tendency to lose oxygen due to the effects of temperature, organisms and nutrients. Moreover, thermal stratification may result in a temperature gradient, with cold water at the greater depths. Thus, in the summer, cold water deficient in oxygen might be released through the power plant, with adverse effects on downstream ecology. The effects can be ameliorated by the use of multiple-level intake structures and by downstream reregulating reservoirs. Some success has been attained with forced air injection to alleviate conditions of low dissolved oxygen.

Air Pollution and Control

Consideration of particulate pollution has long been a factor in planning electric generation facilities. Electrostatic precipitators are standard for almost all new solid fuel and oil fired capacity except where sulphur removal equipment also removes particulate matter. New regulations which demand the highest efficiency equipment for all units increase the pressure on utilities to retire older equipment.

The primary concern is in control of sulphur dioxide emission. Sufficient dispersion of the gases can be obtained through the use of high stacks, however, better control is obtained by using low sulphur content fuels. Based on present availability and price, this could mean a substantial increase in fuel costs, with consequent increase in electrical rates, particularly for smaller residential and commercial customers. Indications are that a commercially feasible sulphur dioxide removal device may be developed by about 1973 for use on new units to go in service by 1977.

Other products of combustion which cause concern are nitrogen oxide and carbon dioxide, however, the effects of such emissions are unclear. Ultimately, such non-combustion processes as nuclear power generation should solve the air pollution problems.

Radioactive Emission

The future holds promise that nuclear energy holds the key to future bulk electrical power supply. Questions dealing with the environmental aspects of nuclear power usually concern how man's air and water environments are affected by the potential release of radioactivity, yet existing nuclear stations adequately meet radiation standards. Other environmental questions which must be resolved before public confidence can be instilled in this method of power generation include control of heated water discharge; methods for handling radioactive fuel; and the problem of disposal of high level radioactive wastes.

Even with these environmental questions, nuclear plants offer better solutions to over-all environmental quality problems than typical coal or oil fueled power plants. Because nuclear generation does not employ a combustion process, there is no discharge of such particulates and gaseous emissions as sulphur dioxide, nitrogen oxides and carbon dioxide. Other benefits are derived through conservation of dwindling fossil fuel reserves. Ultimate resolution of the conflicts involved hinges on complete cooperation between the industry, the regulatory agencies, and the public.

Aesthetic Considerations

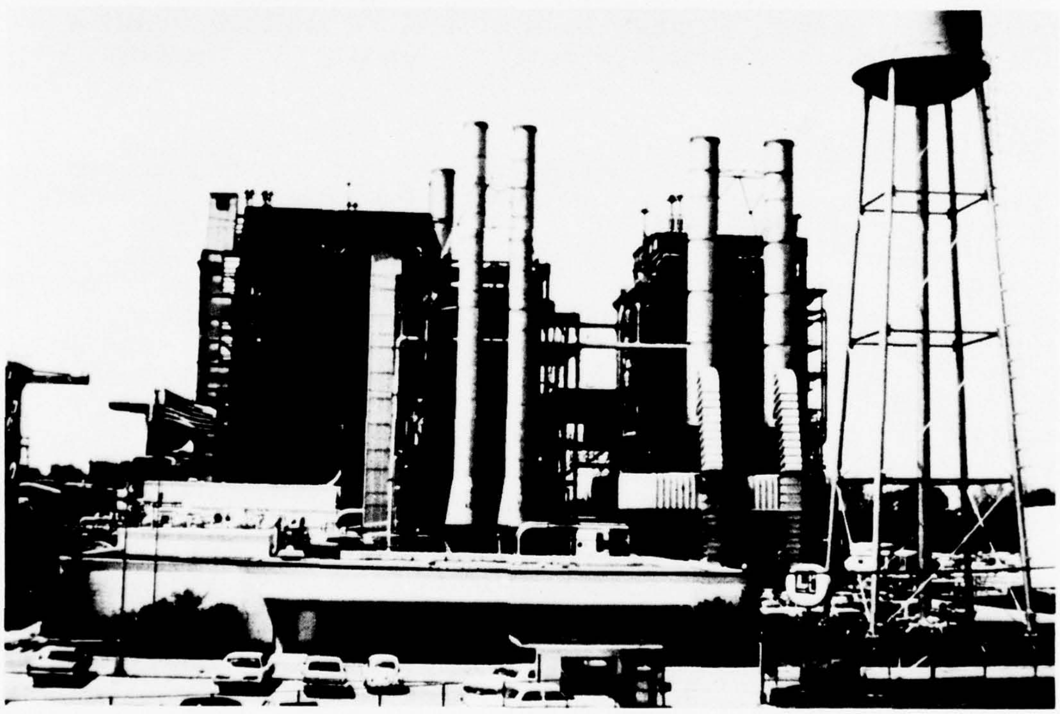
Aesthetic considerations for generating plants and transmission lines are becoming increasingly important. The siting of power plants has been the subject of much research to aid in the reduction of the visual impacts on the environment. Routes for transmission line right-of-way have potential for serious adverse environmental impact. For this reason new construction concepts involve irregular alignment to avoid or minimize adverse impact on public recreation areas, or prime wilderness and scenic areas. In some cases transmission line right-of-way has been used jointly for public parks, hiking trails, grazing of domestic cattle, and cultivation of Christmas trees.

Although distribution lines are being placed underground in certain residential and commercial areas, high voltage transmission lines, today, cannot be placed underground for long distances. The time will come, however, perhaps by conversion from ac to dc, when undergrounding can be more extensively accomplished. In the meantime careful attention is being given to the design of aesthetically pleasing transmission towers and poles. For generating plants and sub-stations, beautification is being attained through careful attention to structural design, architecture, and landscaping.

Federal-State-Citizen Role

The environmental issues associated with electric generation and transmission are such that it is no longer possible for a utility organization to independently choose an economically advantageous site for a plant and then proceed to construct it. Ample lead time must be allowed so environmental factors can be studied thoroughly and reviewed in timely fashion with public agencies and responsible citizen conservation groups. If the future need for facilities is to be met on schedule, official standards and criteria must be established as guides for industry to follow. Such standards can eventually be set through experience gained in practice, and through a broad-based program of research and development.

Ultimately, the cost of providing environmental safeguards will be borne by the consumer. This fact adds a new dimension to the responsibilities of federal, state and local regulatory authorities. Reliability and electrical rates must be viewed in accordance with the degree of environmental protection demanded by the public. Public adjustments to this philosophy will entail a vigorous educational program.



Louisiana Power & Light Company plant, Nine Mile Point, on the Mississippi River.

MARKETING TO SPA PREFERENCE

CUSTOMERS SYSTEMS

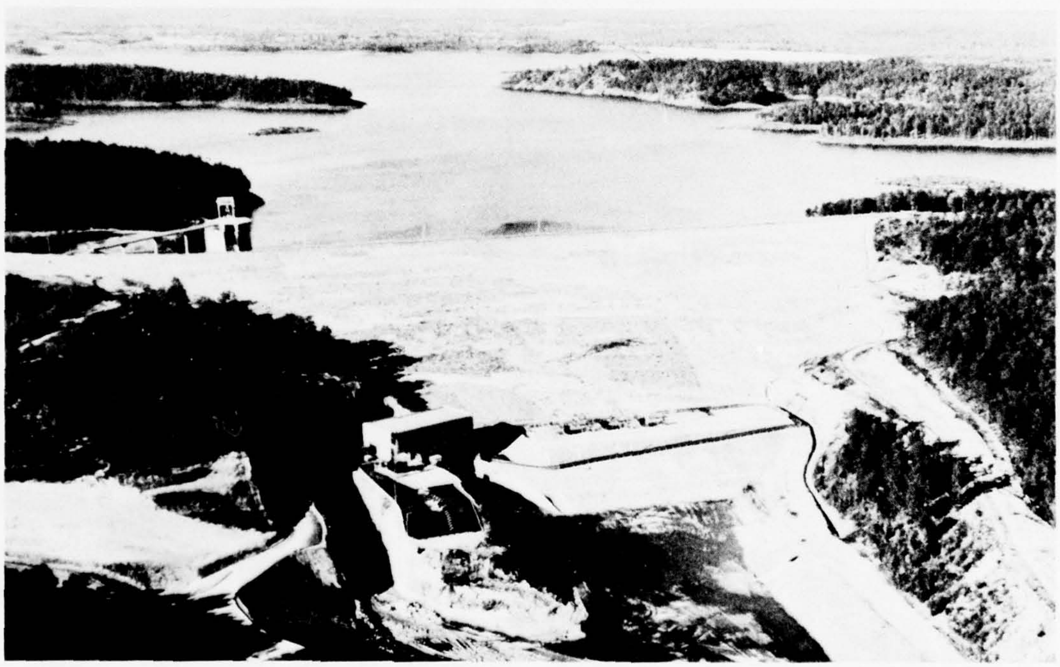
MARKETING TO SOUTHWESTERN POWER ADMINISTRATION PREFERENCE CUSTOMERS SYSTEMS

INTRODUCTION

Flood Control Act of 1944

Congress, which authorizes the construction of Federal multiple-purpose projects, delegated to the Secretary of the Interior authority for marketing power from those projects, with preference given to certain classes of customers, in Section 5 of the Flood Control Act of 1944.

The Secretary of the Interior delegated to the Administrator, Southwestern Power Administration (SPA), the authority and responsibility for marketing the power from Federal hydroelectric projects in southeast Kansas, Missouri, Oklahoma, Arkansas, eastern Texas and Louisiana. In those states in the Lower Mississippi Region the output of future hydroelectric projects would therefore be marketed by the Southwestern Power Administration. Portions of the basin located in the states of Mississippi, Tennessee, and Kentucky are in the marketing regions of Southeastern Power Administration.



The U. S. Corps of Engineers De Gray Project completed in 1971 with a 40-MW conventional unit and a 28-MW pump-back unit.

Contractual Obligations to the Federal Government,
Public Bodies, Cooperatives, and Private Utilities

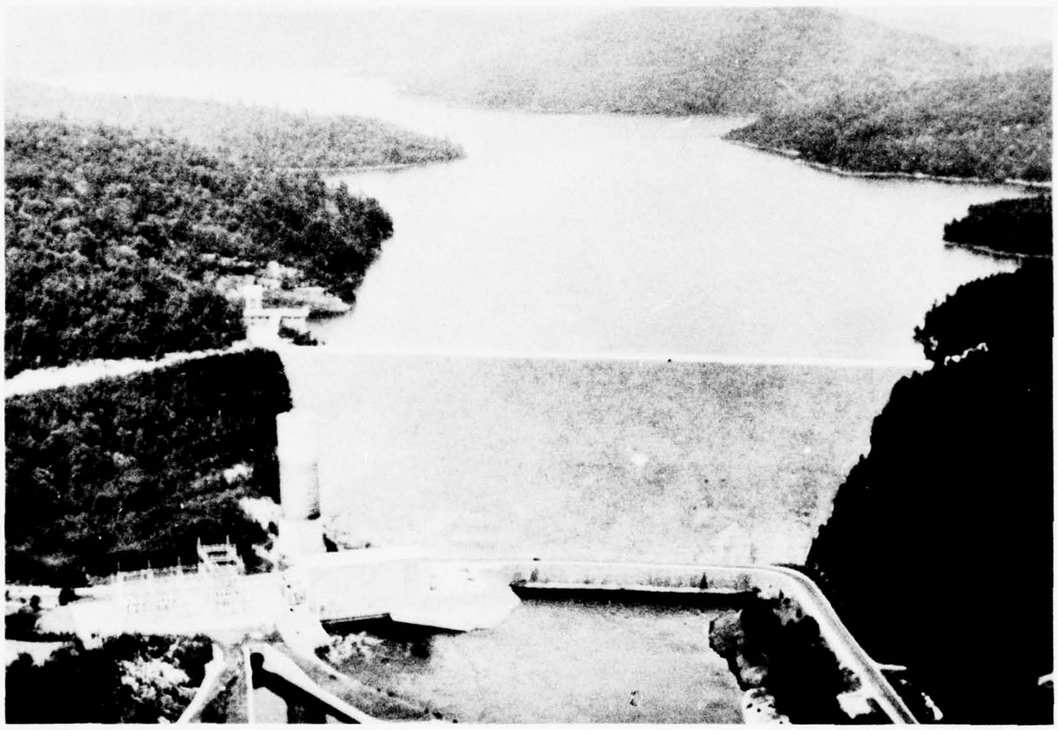
In order to give effect to the preference clause of the Flood Control Act of 1944, several complex wholesale sales, exchange and delivery arrangements have been made with private power companies and with Rural Electrification Administration financed generation and transmission cooperatives. Through these contracts and by direct delivery SPA makes power available in wholesale quantities to preference customers over a broad area including a large portion of the Lower Mississippi Region.

SPA currently has in effect 79 power sales contracts. They include those with 39 municipalities, 15 cooperatives (several of which are generation and transmission cooperatives, G&T), 6 Government installations, 1 public water district, 1 state power agency, and 7 investor-owned utility systems. Of these there are in the Lower Mississippi Region 9 municipalities, 2 G&T cooperatives, and 3 investor-owned utility systems.

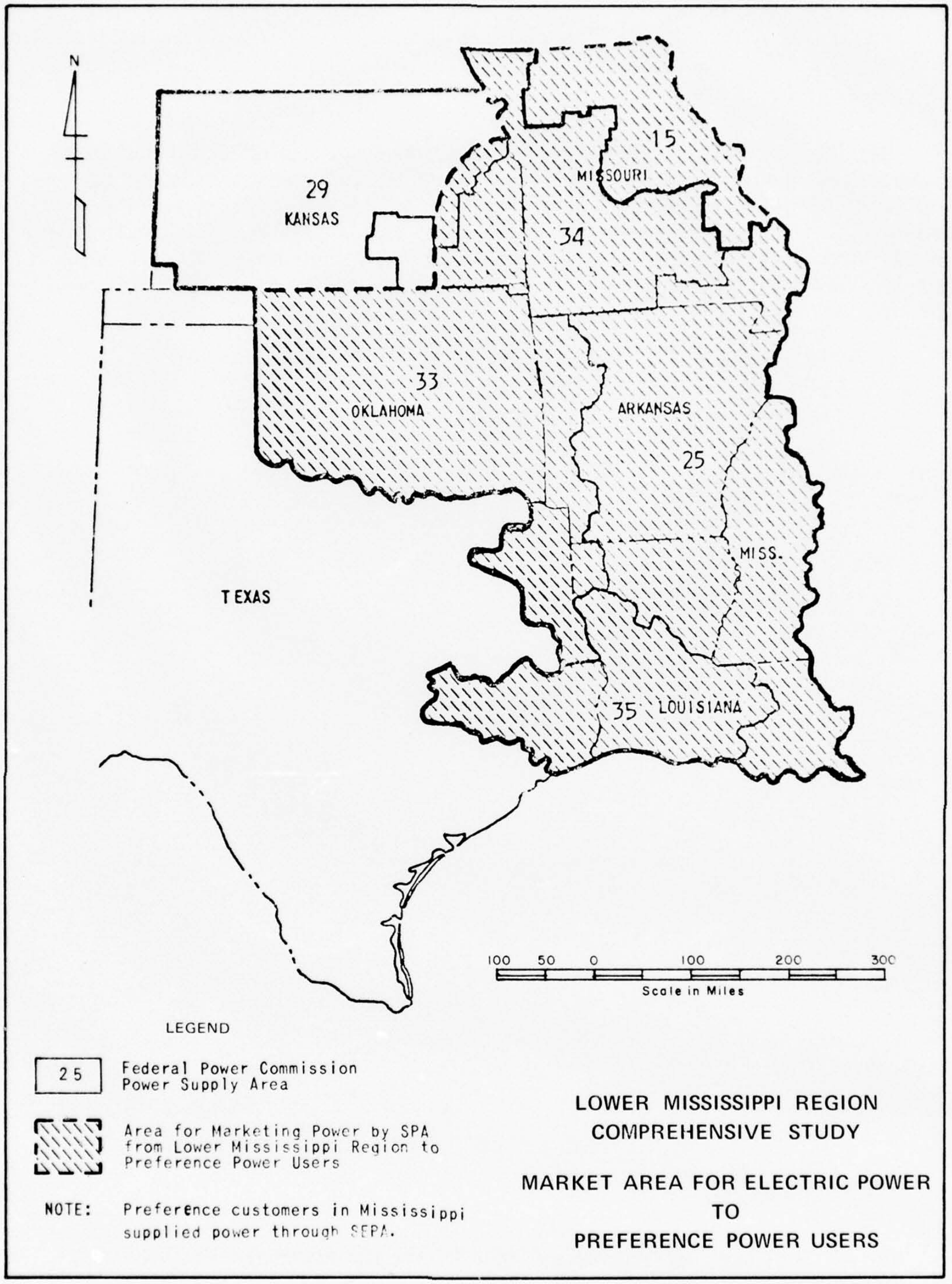
Since the inception of SPA in August of 1943, SPA's total energy sales have been 90 percent firm and peaking, with 10 percent excess energy sales. Of these total sales: 53 percent were to cooperatives, 12 percent were to public bodies, 13 percent were to defense industry and Federal installations, and 22 percent were to investor-owned utility companies.

DESCRIPTION OF POWER MARKET AREA - PREFERENCE POWER USERS

The market area for the users of preference power from the Lower Mississippi River Region, shown on figure 9, consists basically of southeast Kansas, Missouri, Oklahoma, Arkansas, eastern Texas and Louisiana. The market area includes the Federal Power Commission Power Supply Areas 15, 25, 29, 33, 34, and 35, while the Power Market Area for the Southwest Power Pool Area described earlier does not include PSA 15.



The U. S. Corps of Engineers 75-MW Blakely Mountain Project was completed in 1955.


N
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35 LOUISIANA
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Scale in Miles
LEGEND
25 Federal Power Commission Power Supply Area
Area for Marketing Power by SPA from Lower Mississippi Region to Preference Power Users
NOTE: Preference customers in Mississippi supplied power through SEPA.
LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY
MARKET AREA FOR ELECTRIC POWER
TO
PREFERENCE POWER USERS

FIGURE 9

PAST AND ESTIMATED FUTURE POWER REQUIREMENTS - PREFERENCE POWER USERS

Annual Power Requirements

The historical and estimated future annual data on energy for load, peak demands, and load factors for the preference power users portion of the load encompassed in this study is presented in table 12.

The projection to 1990 is based on a composite of the load growth by class of service for each power supply area, in accordance with the load growth forecasts of the Federal Power Commission. The composite trend was extended to the year 2020.

In 1970 the preference power user loads in the marketing area considered represented about 21 percent of the capacity and 17 percent of the energy for the total area load. Because of the difference in class of service being considered the load growth of the preference power users is at a rate less than the total power load growth in Power Supply Areas 25, 29, 33, 34, and 35. The preference power user load is expected to drop to about 11 percent of the area total for both capacity and energy in 1980, and to about 7 percent by the year 2020.

Monthly Power Requirements

The estimated monthly variations in energy requirements, peak demands and load factors of the preference power user load for 1970, 1980, and 1990 are as shown in table 13.

Table 12 - Annual Power Requirements - Preference Power Users

Power Supply Area	Energy for Load (million kWh)	Peak Demand (MW)	Annual Load Factors %	Peak Month
		1960		
15	305	85	41.0	August
25	2,036	563	41.3	July
29	42	10	47.9	August
33	1,870	457	46.7	July
34	2,353	516	52.1	August
35	1,017	282	41.2	July
	7,623	1,913	45.5	
		1970		
15	680	163	47.5	August
25	5,450	1,440	43.2	August
29	96	22	49.0	August
33	4,840	1,228	45.0	August
34	4,660	1,101	48.3	August
35	3,250	828	44.8	August
	18,976	4,782	45.3	
		1980		
15	1,174	278	48.2	August
25	8,482	1,632	59.3	August
29	120	25	54.8	August
33	6,320	1,415	51.0	August
34	7,266	1,542	53.8	August
35	5,370	980	62.6	August
	28,732	5,872	55.9	
		1990		
Total	47,000	9,462	56.7	August
		2000		
Total	66,500	13,390	56.7	August
		2020		
Total	119,000	23,960	56.7	August

Notes: (1) Preference power user loads in the Lower Mississippi Region lie in Power Supply Areas 25 and 35.

(2) Preference customer power requirements in the Lower Mississippi Region are approximately 45 percent of the total area preference customer power requirements.

Table 13 - Monthly Power Requirements - Preference Power Users

Month	Energy Requirements (GWh)	(%)	Peak Demand (MW)	(% Annual)	Load Factor (%)
			1970		
Jan.	1,423	7.5	3,242	67.8	59.0
Feb.	1,347	7.1	3,194	66.8	62.8
Mar.	1,366	7.2	3,199	66.9	57.4
Apr.	1,385	7.3	3,304	69.1	58.2
May	1,461	7.7	3,587	75.0	54.7
June	1,689	8.9	4,223	88.3	55.5
July	2,011	10.6	4,667	97.6	57.9
Aug.	1,993	10.5	4,782	100.0	56.0
Sept.	1,823	9.6	4,242	88.7	59.7
Oct.	1,537	8.1	3,749	78.4	55.1
Nov.	1,442	7.6	3,505	73.3	57.1
Dec.	1,499	7.9	3,481	72.8	57.9
Annual	18,976	100.0	4,782	100.0	45.3
			1980		
Jan.	2,155	7.5	3,981	67.8	72.8
Feb.	2,040	7.1	3,923	66.8	77.4
Mar.	2,069	7.2	3,928	66.9	70.8
Apr.	2,097	7.3	4,058	69.1	71.8
May	2,212	7.7	4,404	75.0	67.5
June	2,557	8.9	5,185	88.3	68.5
July	3,046	10.6	5,731	97.6	71.4
Aug.	3,017	10.5	5,872	100.0	69.1
Sept.	2,758	9.6	5,208	88.7	73.6
Oct.	2,327	8.1	4,604	78.4	67.9
Nov.	2,184	7.6	4,304	73.3	70.5
Dec.	2,270	7.9	4,275	72.8	71.4
Annual	28,732	100.0	5,872	100.0	55.9
			1990		
Jan.	3,525	7.5	6,415	67.8	73.9
Feb.	3,337	7.1	6,320	66.8	78.6
Mar.	3,384	7.2	6,330	66.9	71.9
Apr.	3,431	7.3	6,538	69.1	72.9
May	3,619	7.7	7,097	75.0	68.5
June	4,183	8.9	8,355	88.3	69.5
July	4,982	10.6	9,235	97.6	72.5
Aug.	4,935	10.5	9,461	100.0	70.1
Sept.	4,512	9.6	8,393	88.7	74.7
Oct.	3,807	8.1	7,418	78.4	69.0
Nov.	3,572	7.6	6,936	73.3	71.5
Dec.	3,713	7.9	6,888	72.8	72.4
Annual	47,000	100.0	9,462	100.0	56.7

EXISTING POWER SUPPLY FACILITIES OF PREFERENCE POWER USERS

Preference Power Users' Utility Systems and Thermal Resources

Of the existing thermal generation facilities of the preference power users included in this study, there are 110 generating plants of which 103 (94 percent) belong to municipalities. The majority of the plants are below 10 megawatts in size and principally use thermal combustion engines. Preference power users own 3.6 million kilowatts of generating capacity, of which about 40 percent are in the Lower Mississippi Region.

Existing Hydroelectric Resources Available to Meet Preference Power Users' Load

Table 6 and 9 are lists of the existing hydroelectric resources in the area studied. The hydroelectric plants constructed by the Corps of Engineers are available to meet preference power user load with the power output being marketed by the Southwestern Power Administration. There are numerous preference customers in the Lower Mississippi Region representing a sizable and growing market for power from future conventional and pumped storage hydroelectric developments.

Exchange Contracts

There are no major exchange contracts among the preference power user group. However, during short-term periods of excess or need, several power users have made temporary power displacement arrangements to meet temporary shortages with power from distant plants having excess capability.

A major portion of the power marketing to preference customers by the Southwestern Power Administration is accomplished through contracts with, and facilities of, companies and generating and transmission cooperatives. These contracts include interchange, peaking power sales, energy purchase and/or wheeling arrangements; and require, principally, peaking power from the SPA area. Several of 79 contracts are being renegotiated for rate increases which will aid SPA system repayment requirements.

Purchase Contracts

At the end of 1970 the preference power users owned sufficient generating plants to supply approximately two-thirds of the total load. The other one-third of the power was obtained by purchases from private utility companies and from State and Federal agencies.

Sufficient plant additions have been scheduled so that the preference power users will have capacity to supply a large percentage of their requirements in 1980. However, because of lack of adequate interconnections for full utilization, some of this amount cannot be fully utilized in 1980. Other preference user requirements in 1980 will be purchased from private companies and from State and Federal agencies.

Plant additions have not been scheduled further than about 1980 and cannot readily be forecast at this time. They will be influenced to a large extent by the power that is available for purchase, the transmission interconnections that are available, and the economic feasibility of purchasing power.

Interarea Transfers

SPA has a 161 kV interconnection with the Missouri River Basin system of the Bureau of Reclamation. Because of the hydraulic and electrical load diversities between the two areas, this line increases the marketable capacity available in both areas. This line has been used for the transfer of more than 60 MW of power.

Scheduled Additions

Some of the major plant additions (100 MW or more) being planned by the preference power users are shown in table 14, arranged according to the Power Supply Area in which physically located.

Table 14 - Major Scheduled Additions to Fuel-Electric Generating Capacity of Preference Power Users

Power Supply Area	Utility	Plant	Installed Capacity (MW)	Date in Service
25	City of New Madrid, Missouri1/	New Madrid #1	600	7/72
25	Associated Elec. Cooperative	New Madrid #2	600	1977
33	Western Farmers Elec. Co-op.	Mooreland #3	125	1974
34	Kansas City, Kansas	Quindaro III	145	1/72
34	City of Springfield, Mo.	Southwest #1	200	1976

1/ Operated by Associated Electric Cooperative.

NEED AND UTILIZATION FOR ADDITIONAL CAPACITY

Preference Power Users' Future Load

Estimated additional capacity that will be required by preference power users in 1980 and 1990 is shown in table 15. The capacity retained by the companies, listed in table 15 under "Less Hydroelectric to Companies", is considered essential use of hydroelectric power in supplying total electric service to preference power users.

Table 15 - Additional Dependable Capacity Required to Supply Estimated Preference Power User Load

	1970	1980 (megawatts)	1990
CAPACITY REQUIREMENTS			
Peak Demand	4,782	5,872	9,462
Reserve Requirements (12%)	574	705	1,135
Total	5,356	6,577	10,597
CAPACITY AVAILABLE			
Existing Fuel-Electric (Dependable 12/70)	3,586	3,586	3,586
Less Retirements	-	-	-
Scheduled Additions to Fuel-Electric	-	2,035	2,035
Existing Federal Hydroelectric (Dependable 12/70)	1,446	1,446	1,446
Scheduled Additions to Federal Hydroelectric	-	633	633
Less Hydroelectric to Companies	- 282	- 305	0
Total	4,750	7,395	7,700
ADDITIONAL CAPACITY REQUIRED	606	(818)	2,897

The shapes of the estimated load duration curves for the total loads of the preference power users for 1980 and 1990 are quite similar to the shape of the load duration curves of the Southwest Power Pool (figures 4 and 5).

Hydroelectric Capacity Utilization

SPA, as the principal marketing agency for Federal hydroelectric power in this area, has a marketing program which is designed to require principally peaking power from the hydroelectric projects. The hydroelectric energy is supplemented by off-peak thermal energy either supplied into the SPA system or generated in the system of the customer. Thus, the over-all load shape on the SPA system does not parallel that of the preference customers, but is more of a peaking curve. Under this marketing program SPA is able to use hydroelectric capacity to supply loads of preference customers at approximately 30 percent load factor.

Applying SPA's marketing criteria to preference power user load duration curves the dependable hydroelectric capacity that can be used to supply preference power user loads has been determined for the years 1970, 1980, and 1990 to be 1,964 MW, 2,377 MW, and 2,662 MW, respectively.

For 1980, the amount of usable hydroelectric capacity for preference customer users is 2,072 MW. Of the total hydroelectric plant capacity expected to be available in this area in 1980, 2,079 MW are in multiple-purpose Federal hydroelectric projects. Therefore it is concluded that all multiple-purpose Federal hydroelectric projects that have been found economically and financially feasible in the basins in this area could be utilized by 1980 by the marketing agency on preference user load, and/or to serve to companies or cooperatives under existing wheeling and energy purchase arrangements in exchange for service to preference customers.

NEEDS RELATED TO POWER

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N E E D S   R E L A T E D   T O   P O W E R

ENERGY AND PEAK LOAD NEEDS BY WRPA

Estimates of energy and capacity requirements for each WRPA for the years 1970, 1980, 2000, and 2020 for both the national income program and the regional development program are listed on table 16. The regional development program assumes a greater population growth than the national income program. These different programs are explained in detail in Appendix B, Economics.

Table 16 - WRPA Energy and Peak Load Needs

WRPA 1/	Year	National Income Program Energy (gigawatt hours)	National Income Program Peak Load (megawatts)	Regional Development Program Energy (gigawatt hours)	Regional Development Program Peak Load (megawatts)
2	1970	2,593	592	2,593	592
	1980	4,532	1,023	4,867	1,099
	2000	13,223	2,936	14,810	3,288
	2020	22,575	5,013	26,187	5,815
3	1970	10,260	2,597	10,260	2,597
	1980	17,205	4,009	18,891	4,402
	2000	32,269	7,442	36,690	8,462
	2020	58,368	13,461	67,765	15,628
4	1970	3,044	701	3,044	701
	1980	5,388	1,220	5,878	1,331
	2000	19,001	4,253	21,547	4,823
	2020	32,617	7,301	37,053	8,294
5	1970	12,944	2,573	12,944	2,573
	1980	23,235	4,595	24,699	4,884
	2000	67,932	13,440	77,035	15,241
	2020	115,980	22,991	131,985	26,163
6	1970	1,963	453	1,963	453
	1980	4,138	943	4,415	1,006
	2000	11,290	2,527	11,855	2,653
	2020	19,140	4,284	21,016	4,704
7	1970	1,616	364	1,616	364
	1980	3,235	723	3,575	799
	2000	8,197	1,816	9,541	2,114
	2020	13,940	3,089	16,324	3,618
8	1970	12,631	2,090	12,631	2,090
	1980	26,070	4,221	28,103	4,550
	2000	90,181	14,398	101,003	16,126
	2020	158,060	25,235	179,398	28,642
9	1970	6,384	1,256	6,384	1,256
	1980	13,440	2,600	14,381	2,782
	2000	42,219	7,900	47,792	8,943
	2020	73,550	13,300	82,670	14,949
10	1970	19,786	4,428	19,786	4,428
	1980	39,163	8,158	42,257	8,802
	2000	106,869	21,863	119,159	24,377
	2020	180,170	36,859	204,493	41,835
Region	1970	71,221	15,054	71,221	15,054
	1980	136,406	27,492	147,066	29,655
	2000	391,181	76,575	439,432	86,027
	2020	674,400	131,533	766,891	149,648

1/ Capacity and energy for any WRPA may be associated with WRPA 1.

The principal demand imposed on the water supply by thermal electric generating plants is that for condenser cooling water. Boiler makeup water is required for all steam-electric plants and also some coal-fired installations use water for sluicing ashes. These latter two uses have relatively minor effects on the water supply, therefore their future magnitudes have not been projected.

Steam-electric plants operate through the thermodynamic process known as the Rankin cycle. Steam produced at high temperature and pressure in the boiler, or reactor of a nuclear unit, flows through the turbine giving up energy to the turbine rotor which drives the generator to produce enectricity. At the exhaust of the turbine, the steam is condensed to water and returned to the boiler for a repetition of the cycle. A large amount of heat is given up in the condensing process to the cooling water circulated through the condenser.

The amount of waste heat discharged to the condenser is directly related to the heat rate of the plant and the type of plant. In a fossil-fueled plant, approximately 15 percent of the heat is lost in the boiler, the stack, the turbines and generators, and in station use. The generator output is 3,413 Btu per kWh and the remainder is lost in the condensing process. Thus, for a plant with a heat rate of 9,500 Btu per kWh the heat loss to the condenser would be approximately 4,700 Btu/kWh. In the nuclear-fueled plants, heat losses through the stack are not involved and the in-plant losses amount to five percent or less of the thermal input. Therefore, the amount of heat discharged through the condenser is substantially greater in a nuclear plant than in a fossil plant with the same heat rate. Contemporary nuclear plants are not yet as efficient as fossil-fueled plants as the temperature of the throttle steam is not as high.

For a given rate of heat removal, the temperature rise in the cooling water is inversely proportional to the amount of water circulated through the condenser. The size of the condenser and amount of water circulated can be varied substantially. The usual design is for a temperature rise through the condenser in the range of 10 to 20 or more degrees Fahrenheit, with the average being about 15 degrees Fahrenheit.

The heat which is removed by the circulating water as it passes through the condenser may be dissipated to the atmosphere in several ways: (1) once-through method, where the cooling water is taken from a source, passed through the condenser, and returned to the source body of water; (2) wet towers, where the cooling water is recirculated through the condenser after it has been cooled in an evaporative cooling tower or other cooling system where the water is exposed to circulating air; and (3) dry towers, where the cooling water is recirculated in a closed system and its heat dissipated to the air through heat exchangers.

Condensed cooling water is considered in three aspects - (1) the amount of water that is required to flow through a condenser in order to condense the steam; (2) the amount of cooling water which is evaporated as a result of the increase in temperature; and (3) the amount of water that is actually withdrawn from the water supply. Either or all of these aspects can be critical in designing and selecting a site for a power plant.

COOLING WATER NEEDS BY WRPAs, 1970-2020

Firm planning for future generating capacity is often not completed until about four years before the need becomes apparent except for nuclear units which require about eight years lead time. Accordingly, it should be realized that estimates of cooling water needs as of the years 1980, 2000 and 2020 can only be a rough guide to be reviewed periodically as new situations develop.

Using WRPA estimates of energy and peak load needs contained in table 16, cooling water needs for the years 1970, 1980, 2000, and 2020 by WRPAs and the Lower Mississippi Region were determined for the national income program as shown on table 17 and for the regional development program on table 18.

Table 17 - Thermal-Electric Cooling Water Needs for National Income Program

WRPA 1/	Year	Cooling Water Needs 2/ Condenser Requirements (billion gal)	Withdrawals (billion gal)	Consumptive Use (billion gal)
2	1970	97	82	0.72
	1980	148	98	1.03
	2000	345	234	2.79
	2020	515	280	4.42
3	1970	397	328	2.88
	1980	561	372	3.93
	2000	842	571	6.82
	2020	1,330	723	11.40
4	1970	117	98	0.87
	1980	189	125	1.32
	2000	496	336	4.01
	2020	744	404	6.38
5	1970	484	408	3.59
	1980	757	502	5.30
	2000	1,819	1,234	15.20
	2020	2,700	1,463	24.50
6	1970	72	59	0.53
	1980	135	89	0.94
	2000	294	200	2.39
	2020	437	237	3.74
7	1970	59	50	0.44
	1980	105	69	0.73
	2000	214	145	1.73
	2020	318	173	2.72
8	1970	495	404	3.63
	1980	977	648	6.74
	2000	2,550	1,730	23.50
	2020	3,790	2,060	33.90
9	1970	235	193	1.73
	1980	438	290	3.07
	2000	1,100	747	8.92
	2020	1,760	955	17.50
10	1970	733	608	5.43
	1980	1,280	846	8.94
	2000	2,790	1,890	22.60
	2020	4,190	2,270	37.90
Region	1970	2,689	2,230	19.82
	1980	4,590	3,039	32.00
	2000	10,450	7,087	87.96
	2020	15,784	8,565	142.46

1/ The generation required to meet the load and the corresponding water needs for generation for any WRPA may be associated with WRPA 1. Actual use for plants 25 MW and larger, taking water from WRPA 1 is shown in Methodology section for comparative purposes. (Data became available subsequent to preparation of table.)

2/ Water use for 1970 based on energy requirements in individual WRPA's and therefore may not match actual water use.

Table 18 - Thermal-Electric Cooling Water Needs for Regional Development Program

		Cooling Water Needs 2/		
WRPA 1/	Year	Condenser Requirements (billion gal)	Withdrawals (billion gal)	Consumptive Use (billion gal)
2	1970	97	82	0.72
	1980	159	105	1.11
	2000	386	262	3.13
	2020	598	325	5.12
3	1970	397	328	2.88
	1980	616	408	4.31
	2000	957	650	7.75
	2020	1,550	840	13.30
4	1970	117	98	0.87
	1980	206	136	1.44
	2000	562	382	4.55
	2020	846	459	7.24
5	1970	484	408	3.59
	1980	805	534	5.64
	2000	2,061	1,399	17.27
	2020	3,070	1,664	27.90
6	1970	72	59	0.53
	1980	144	95	1.01
	2000	309	210	2.51
	2020	480	260	4.11
7	1970	59	50	0.44
	1980	117	77	0.82
	2000	249	168	2.02
	2020	372	202	3.19
8	1970	495	404	3.63
	1980	1,050	699	7.27
	2000	2,860	1,940	26.30
	2020	4,300	2,330	38.40
9	1970	235	193	1.73
	1980	469	311	3.28
	2000	1,250	846	10.10
	2020	1,980	1,070	19.70
10	1970	733	608	5.43
	1980	1,380	913	9.64
	2000	3,110	2,110	25.20
	2020	4,750	2,580	43.10
Region	1970	2,689	2,230	19.82
	1980	4,946	3,278	34.52
	2000	11,744	7,967	98.83
	2020	17,946	9,730	162.06

1/ The generation required to meet the load and the corresponding water needs for generation for any WRPA may be associated with WRPA 1. Actual use for plants 25 MW and larger, taking water from WRPA 1 is shown in Methodology section for comparative purposes. (Data became available subsequent to preparation of table.)

2/ Water use for 1970 based on energy requirements in individual WRPAs and therefore may not match actual water use.

METHODOLOGY

M E T H O D O L O G Y

FORECAST OF POWER REQUIREMENTS

In the FPC's method of forecasting future power requirements population is the principal guide used, except for electric energy trends. Bureau of Census projections for states are utilized and revised to conform to power supply areas. In order to develop this data, historical trends of population by groups of counties are developed and projections are then made. Total population projections of power supply areas equal the sum of state projections as prepared by the Bureau of Census. Estimates of power requirements are then completed for different classifications of energy consumers.

Farm Requirements Excluding Irrigation and Drainage Pumping

In preparing an estimate of farm use (excluding irrigation and drainage pumping), the historical data on numbers of farms as defined in the Census of Agriculture is projected into the future. Numbers of farms have been decreasing due to low farm income, rapid growth in commercial farming, larger sized farms, higher equipment costs, increasing hourly labor costs, etc. Farm sizes are increasing and commercial farming is becoming "big business" in many areas. Since rural electrification reaches substantially all rural areas in the country, the numbers of farms electrified as used in the load forecast is nearly as large as the total number of farms. A kilowatt-hour per customer use figure is applied to the number of electrified farms to arrive at total consumption. This use figure is based on historical trends, types of farming in the area, and predictions of future farming activities and new methods of electrification of farm equipment and machinery.

Future farm population is determined by trends of numbers of persons per farm and total number of farms. This farm population is subtracted from total population to arrive at the non-farm residential population which is related to non-farm residential energy consumption.

Irrigation and Drainage Pumping

Irrigation and drainage pumping requirements are predicated on historical trends and an examination of future requirements, keeping in mind amounts of irrigable land and water supplies available for irrigation.

Non-Farm Residential

In the preparation of a load forecast for non-farm residential sales, types of appliances and energy use per appliance were determined for the average home for 1965 and 1966 and predictions are made for the Southwest Power Pool area as a whole. These projections provide guidance for determining appliance saturation and include an increment for the potential development of new appliances. In this respect, it is interesting to note that there have been very few new appliances developed for the home in recent years that use sizeable quantities of electric power. Many appliances and domestic uses have increased in size and in electric consumption.

In preparing the energy forecast, the non-farm residential population was divided by the number of persons per residence to arrive at the number of residential customers. One hundred percent electrification was assumed. The kilowatt-hours per customer were projected by power supply areas and an examination of these trends shows that they show regular annual increases.

Commercial

In order to relate commercial energy sales to population trends, the number of persons per commercial service is calculated by power supply areas and trended by years for which historical data are available and extended to 1990. The kilowatt-hour energy consumption for commercial service was trended historically and projected to 1990.

Industrial

The industrial classification of energy sales is the largest single category and is expected to remain the largest throughout the period covered by this report. Historical trends of industrial sales are examined, plotted, and extended into the future based on judgment, information obtained from the electric utility industry, economic indicators, and industrial statistics available from federal agencies, state bureaus, and other sources. As a guide in the projection of industrial trends, the regional office of the Federal Power Commission maintains a card file of existing and projected industrial customers on which production, employment, and other statistics are entered. Further, electric utility requirements of principal segments of the industrial category are plotted for such as cement, refineries, petrochemical plants, etc., when adequate data can be assembled. Industrial sales represent by far the most difficult category to predict into the future. It can readily be seen that one new major aluminum reduction plant supplied by the electric utility industry could radically affect industrial sales in any power supply area. As a whole, however, the forecast attempts to provide for new plants and new industrial processes that may be developed during the period covered by the forecast.

Industrial production, while subject to fluctuations of short duration, has shown a persistent upward trend since the beginning of the Industrial Revolution. The Federal Reserve Board index of industrial production provides a good economic indicator for the power supply areas in each Federal Reserve district. The gross national product is also used as a reference but, like other national indicators, cannot be directly factored into a load forecast.

Street and Highway Lighting

The energy requirements for street and highway lighting provide a very smooth trend of growth. These sales are related to numbers of non-farm residential customers and the future projections are based on this relationship but keeping in mind street and highway lighting promotional programs for safety and crime prevention.

Electrified Transportation

The decreasing sales for electrified transportation are so small that no projected use is shown after 1970. Should it appear that high-speed electrified transportation will develop in the Southwest Power Pool area, a commensurate projection of energy requirements must then be made.

All Other

This category of sales includes many different uses of electric energy such as Government facilities, water pumping, city buildings, utility offices, etc.

Losses and Energy Unaccounted For

Projections of losses and energy unaccounted for are based on historical trends. Losses represent a varying percentage of total energy requirements but the trends are fairly constant and can be projected with a reasonable margin. Upgrading of distribution facilities and major transmission extension programs affect losses.

Total Energy for Load

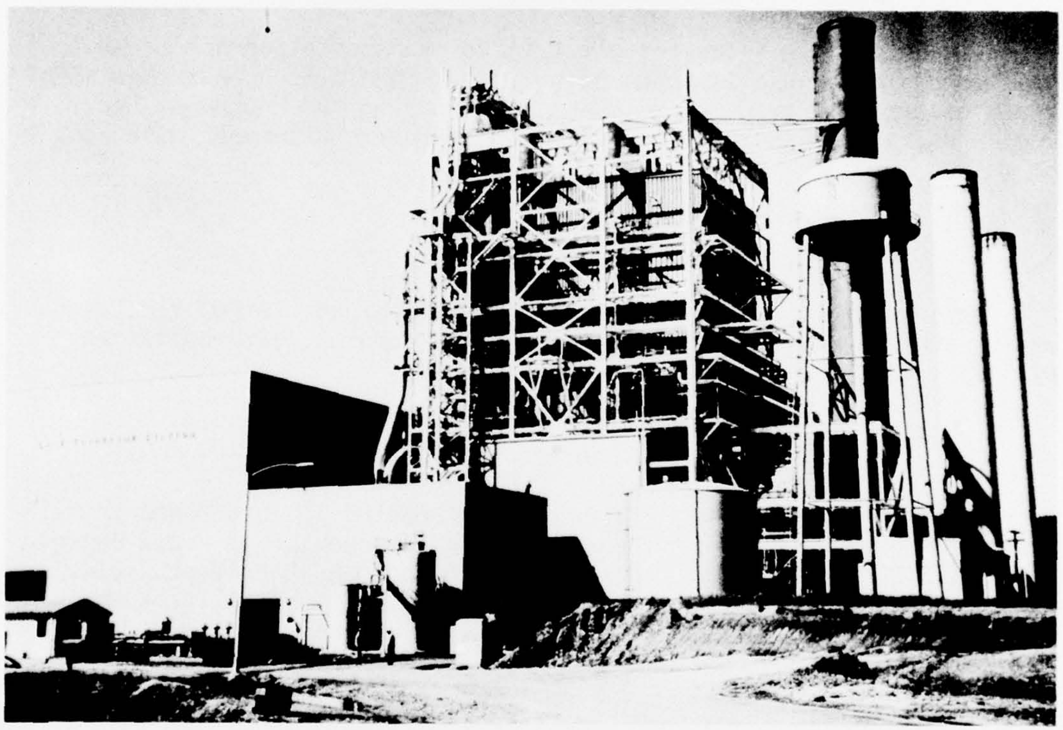
The total energy for load is derived by the addition of the nine classifications listed above which provide projections to 1990. Projections beyond 1990, to the year 2020, are estimated on a straight line basis which provides a decreasing percentage rate of growth in the power industry.

Peak Load

The peak load for each PSA is developed by using historical trends of peak demands and load factors. Load factors are projected throughout the study period and applied to the total energy for load estimates to arrive at an estimate for peak load.

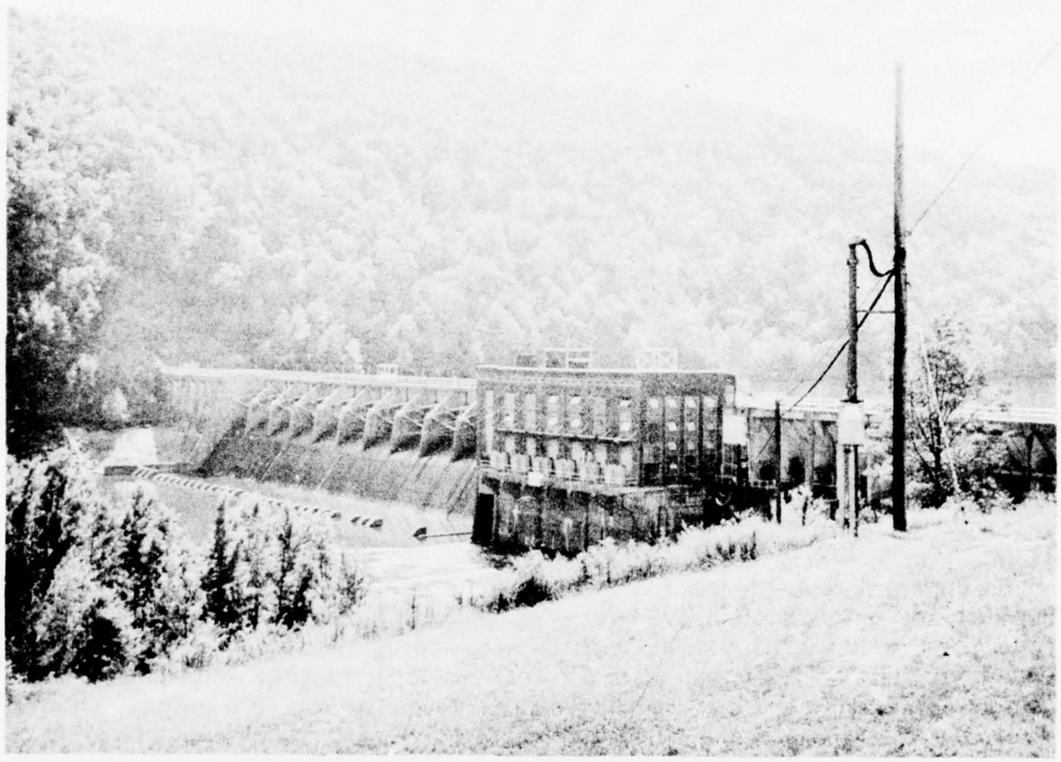
Power Requirements by WRPA

Energy requirements and peak load estimates for each WRPA were developed by trending historical data and relating this to the particular PSA in which each WRPA is located. Total WRPA projection of energy requirements and peak loads equal the sum of PSA projections, the results of which are shown in table 16.



Arkansas Power & Light Company's Lake Catherine steam-electric generating plant has capacity of 756.5 MW.

In determining if existing and potential hydroelectric peaking capacity would have sufficient energy available during heat storms and drouth conditions to be usable on the estimated 1980 and 1990 peak loads in the power market area, use was made of a report prepared in 1969 by the Hydro Utilization Subcommittee of the South Central Regional Advisory Committee on up-dating the National Power Survey. Discussion of consideration given to hydroelectric power in the Power Market Area including the Lower Mississippi Region is contained in Appendix T, Plan Formulation.



Arkansas Power & Light Company's Remmel hydroelectric plant, a part of Licensed Project 271, has three units with total installed capacity of 9.3 MW.

WATER REQUIREMENTS FOR POWER

Predictions of cooling water requirements for steam-electric generation beyond 1980 are complicated by several factors - two of the principal factors being the accuracy of predicted total energy requirements beyond that date and the mix of future power supply. The electric industry is one of the most dynamic industries in the United States, having experienced between six and seven percent annual growth rate for a number of years and up to ten percent in some areas as compared to a somewhat lower rate for the GNP. The technology of electric generation is also changing rapidly as demonstrated by the larger and larger units made possible by the rapid load growth and stronger interconnection between neighboring systems, the increasing reliance on extra high voltage transmission, the large increase in the number of scheduled nuclear-fueled plants, and the effect that environmental considerations are having on present and future expansion plans. Also, new methods of generating power are under active consideration which eliminate the conventional heat cycle and thus eliminate the need for cooling water.

In estimating cooling water requirements for the 10 Water Resources Planning Areas (WRPA's) it has been assumed that energy requirements of an area will be supplied by generation located within that area. Water requirements by thermal plants for each WRPA have been completed on this basis, results of which are shown in tables 17 and 18. Although there is a high degree of interconnection and coordination existing between electric systems operating in the Lower Mississippi Region it is not considered practical to predict plant location through the year 2020 and attempt to estimate the import or export of electric energy to each of the WRPA's. In estimating condenser cooling water requirements average water use factors and heat rates shown on table 19 were used. Withdrawals were determined by applying to condenser requirements, recirculation rates as found in table 4-3-3 of the First National Assessment of the Water Resources Council, 1968, for the Lower Mississippi. It has been assumed that, due to technological improvements, the rate of consumption will decrease in future years for each of the types of cooling systems now in use. However, it will be noted that the tables in this appendix indicate a slightly increasing rate of consumption in the projections for future years. This results largely from the trend toward a tremendous increase of generation in the face of public awareness of environmental considerations. The availability of plant sites and adequate cooling water or other factors involved. Thus there is every indication that the use of once-through cooling systems will decrease to be replaced by cooling ponds and cooling towers. Of all electric energy generated in the Lower Mississippi Region in 1970, approximately 80 percent was generated by plants with once-through cooling systems. It is estimated that by the year 2020 only 60 percent of the energy will be generated at plants with once-through cooling and that cooling towers will service a major portion of the other 40 percent.

In the preparation of Appendix K, Municipal and Industrial Water Supply, a different approach was used in compiling 1970 and 1980 water use for electric power generation. Explanation of the methodology used is included in that appendix.

Table 20 was prepared to indicate cooling water withdrawals as reported for 1970 by utilities operating within the Lower Mississippi Region who were required to report on FPC form 67, Steam-Electric Plant Air and Water Quality Control Data. This indicates that approximately 75 percent of cooling water withdrawals within the Lower Mississippi Region are from the Mississippi River, irrespective of WRPA location of the generation.

Table 19 - Average Factors for Estimating Water Requirements for Steam-Electric Plants

Item	Fossil Fuel	Nonbreeder Reactors	Breeder Reactors
Average Heat Rate - Btu/kWh			
1965	10,000	-	-
1980	8,900	-	-
2000	8,000	-	-
2020	7,500	-	-
Condenser Requirement (15° F. Temp Rise) - million gal /GWh			
1965	40.75	60.31	-
1980	32.60	45.64	-
2000	26.08	32.60	26.08
2020	22.82	26.08	22.82
Consumptive Use for Once Through Systems - million gal /GWh			
1965	0.326	0.456	-
1980	0.228	0.293	-
2000	0.196	0.261	0.196
2020	0.163	0.228	0.163
Consumptive Use for Cooling Ponds - million gal /GWh			
1965	0.359	0.522	-
1980	0.261	0.326	-
2000	0.228	0.293	0.228
2020	0.196	0.261	0.261
Consumptive Use for Evaporative Cooling Towers - million gal /GWh			
1965	0.522	0.652	-
1980	0.424	0.554	-
2000	0.359	0.456	0.359
2020	0.326	0.391	0.326

Table 20 - Cooling Water Withdrawals for Steam-Electric Generation in the Lower Mississippi Region - 1970 1/

WRPA	Utility	Plant	Installed Capacity (megawatts)	Cooling Water Withdrawals (billion gal)
2	Arkansas Power & Light	Robert E. Ritchie2/	903.6	128
2	Arkansas Power & Light	Hamilton Moses	138.0	1
2	Arkansas Electric Coop.	Carl E. Bailey	120.0	22
3	City of Memphis, Tenn.	Thomas H. Allen2/	990.0	157
4	Mississippi Power & Light	Baxter Wilson2/	544.6	114
4	Mississippi Power & Light	Delta	220.5	1
5	Arkansas Power & Light	Lake Catherine	757.0	200
5	Louisiana Power & Light	Sterlington	351.5	134
5	City of Monroe, La.	Power Plant	166.0	38
7	Mississippi Power & Light	Natchez2/	66.0	3/
8	Gulf States Utilities	Willow Glen2/	994.4	154
8	Gulf States Utilities	Louisiana2/	428.0	2
9	Gulf States Utilities	Roy S. Nelson	982.3	1
9	Central Louisiana Electric	Coughlin	483.3	15
9	City of Alexandria, La.	D. G. Hunter	97.5	3/
9	Central Louisiana Electric	Teche	79.4	18
9	City Of Lafayette, La.	Doc Bonin	143.4	3/
9	City of Lafayette, La.	Rodemacher	42.7	3/
10	Louisiana Power & Light	Little Gypsy2/	1,250.8	328
10	New Orleans Public Service	Michoud2/	959.3	220
10	Louisiana Power & Light	Nine Mile Point2/	351.3	100
10	New Orleans Public Service	A. B. Paterson2/	218.3	42
10	New Orleans Public Service	Market Street2/	96.3	26
	Total		10,384.2	1,705

1/ From utilities required to report on plants 25 MW or larger on FPC Form 67, Steam-Electric Plant Air & Water Quality Control Data, and comprising the major portion of electric power generation facilities in the Region.

2/ Plant actually withdraws water from WRPA 1. These plants constitute 6,802.6 MW of the installed capacity and account for 1,271 billion gallons of cooling water withdrawals.

3/ The total estimated withdrawals for these four plants in 1970 approximates one-half billion gallons, partly from wells.


WATER RESOURCES PLANNING AREAS
1
MO.
ARK.
KY.
TENN.
3
2
TENN.
MISS.
4
5
ARK.
LA.
6
7
MISS.
LA.
8
8
10
9
10